CASSELL'S

CYCLOPÆDIA OF MECHANICS

CASSELL'S

CYCLOPÆDIA OF MECHANICS

CONTAINING

RECEIPTS, PROCESSES AND MEMORANDA FOR WORKSHOP USE

BASED ON PERSONAL EXPERIENCE AND EXPERT KNOWLEDGE

WITH 1,200 ILLUSTRATIONS AND AN INDEX OF 8,500 ITEMS

EDITED BY

PAUL N. HASLUCK

EDITOR OF "WORK" AND "BUILDING WORLD," AUTHOR OF "HANDYBOOKS FOR HANDICRAFTS," ETC. ETC.

FIRST SERIES

CASSELL AND COMPANY, LIMITED

LONDON, PARIS, NEW YORK & MELBOURNE

1900


BELLE
SAUVAGE

PREFACE.

CASSELL'S CYCLOPÆDIA OF MECHANICS contains in a form convenient for ready reference and everyday use receipts, processes, and memoranda selected from a rich store of choice information contributed by a staff of skilful and talented technicians, upon whose practical experience and expert knowledge the information is based. The matter contained in this volume has been carefully digested, freely illustrated, and made plain to those inexperienced.

All compilations of receipts and memoranda for the use of mechanics that have been published—and some have attained great popularity—differ from the present work in the important fact that every item in this volume is the paid contribution of an expert, written specially to satisfy the want of an inquirer, and each has challenged emendation from a wide circle of practical men. Corrective and supplementary matter supplied by these critical readers has been incorporated to ensure the greater efficiency of this work.

A superficial glance through the pages of this volume might tend to a false impression that the varied contents are not readily available for easy and systematic reference. However, this is not so. Experience has shown that it is not possible to classify paragraphs that often include matters essentially different so that there shall be a definite place for every item, and the impossibility of such a course is particularly emphasised in the present collection, which embraces subjects widely diversified. Even a little consideration of this Cyclopaedia would show that no possible arrangement of the paragraphs would place them so that the several facts contained in each could be found with ease and certainty. The copious index provides a means by which every separate particular and detail of any kind dealt with in the volume may be traced and referred to with the least amount of trouble. This index also brings together every reference to the same subject, however widely they may be scattered, and all varied notes included under one heading are properly analysed and, thus disclosed, regrouped with kindred topics. No pains have been spared in the compilation of this index, which efficiently serves

a purpose impossible to be met by any arrangement of paragraphs comprising the volume.

Amongst the items embodied in this work probably every reader can find some that contain information already known to him. Possibly some readers may be able to supplement the particulars given in respect of matters with which they are familiar. Any authentic supplementary particulars that are likely to be of benefit and that would increase the usefulness of the information will be welcomed, and should be sent to the undersigned, with the view to including them in a second volume, now in preparation, that will be issued when ready.

Additional information or instruction on special details of the matters dealt with in CASSELL'S CYCLOPÆDIA OF MECHANICS may be obtained by addressing a question to *Work* or *Building World*, from the contents of which journals this Cyclopædia has been compiled, so that it may be submitted to the staff of contributors and answered in the columns of one of those journals in the usual course.

P. N. HASLUCK.

LA BELLE SAUVAGE,
LONDON.

September, 1900.

INDEX TO ILLUSTRATIONS.

(The Contents Index is on pp. 355–383.)

CASSELL'S
CYCLOPÆDIA OF MECHANICS.

Refilling Fitzroy Barometer.—It is not an easy matter for an inexperienced person to fill a barometer properly. The tube and mercury must first be made warm. The mercury may be heated to the boiling point of water in an iron vessel; a vessel having tin in its composition must on no account be used. The glass should be warmed sufficiently to ensure the evaporation of all moisture. Make a paper funnel having but a very small aperture and pour in the mercury, whose impurities will cling to the paper funnel, and test for correct amount with a standard barometer. Be careful that air does not enter with the mercury. If an odd air-bubble appears, send up a little more to collect, and send up to the top what has already entered.

Making Lantern Slides.—Lantern slides are made from prints, photographs, etc., in the following way. Make a negative of the subject by copying in the camera in the usual way. Focus the picture sharply within a square 3¼ in. by 3¼ in., leaving ¼ in. each way for binding and masking. Copying is merely photographing at close quarters. If the camera will not extend far enough to obtain a picture of the required size, the lens and front can be removed from the camera proper, and the camera lengthened by attaching to it a box at one end of which the lens and front can be fitted, the join between the box and the camera being covered with a dark cloth. From the negative thus obtained a lantern slide may be made either by contact or through the camera. Making slides by contact is the simpler plan if the lantern plate is large enough to contain the whole of the picture. Place the lantern plate in contact with the negative (film to film) in the dark room and expose to the light of a gas flame; a thin image is developed. Bromide plates are the least troublesome to use, and a simple developer is metol and soda. After development, the plate is fixed and washed as usual. When the negative is dry a mask is laid on the film side, and over the mask is placed a carefully cleaned cover glass; the two glasses are then bound together with strips of black gummed paper. The glasses should be gripped firmly in the centre with the thumb and forefinger of the left hand, and the moistened paper laid along the top edge in position and smoothed gently towards the two ends. When dry, do the opposite side, then the remaining sides. Lastly, clean off any gum and finger marks. For copying through the camera, the negative should be fixed in the bottom of the box, glass side out (so that the sides of the box shade the film), and either placed on a slanting board pointing to the clear sky, or set up on a table in front of a lamp shaded with a sheet of ground glass. The picture is then focussed to the desired size, and the exposure is made by daylight, if possible, or by artificial light, such as a lamp or a piece of magnesium ribbon burnt behind ground glass. Masks can be bought; they are used to define the extent of the picture to be shown on the screen. The cover glass protects the film of the negative. The binding strips can also be bought; their use is obvious. A white spot (a small circular piece of white paper) is placed in each of the top corners of the negative as a guide to the lantern operator. When photographs or book prints are to be copied on to slides the grain of the paper may be got rid of by wetting the print or photograph and squeegeeing it on to clean glass, carefully stroking out the air bubbles between the print and the glass. If it is not desirable to wet the photograph it may be put in a printing frame with glass before it and then exposed before the camera. A line drawing may be copied the same size by coating a piece of glass 3¼ in. by 3¼ in. with a weak solution of gelatine. The glass should be placed over the design and a tracing made on the gelatine film with pen and ink (Stephens' ebony stain answers well). When very fine lines are required the film may be rubbed with medium and a retouching pencil used. This tracing can be used as a lantern plate. The masking, binding, and fixing of the cover glass are described above.

Making Socket Joint in Steam Pipe.—The proportions for a cement for the socket joint of a steam pipe are, by weight, 1 part of powdered sal-ammoniac, 2 parts of flour sulphur, and 80 to 100 parts of borings; the borings should be pounded if large. These ingredients must be well mixed and moistened with water, and will be ready for use in from one to two hours. Caulk the socket two-thirds full of yarn, and finish with one-third of borings. The less borings used the better, for a slight expansive action occurs in the borings when setting, and this causes the splitting of sockets. If there are only one or two joints, get some white lead and add sufficient dry red lead to make a stiff putty; thin a little of this with boiled oil, and paint inside the socket first. Then caulk in alternate layers of yarn and putty, commencing with the yarn and finishing with the putty. This cement is longer in setting than the former one.

Etching on Steel.—All processes of steel etching depend on the coating of the steel with a resist, which is scraped away from those portions to be etched or bitten into by chemical action. The resist or etching ground is made by melting together over a slow fire black pitch, white wax, Burgundy pitch, asphaltum, and gum mastic. Other etching grounds are (1) asphaltum varnish; (2) yellow beeswax dissolved in turpentine and continuously decanted until no sediment remains—to 6 parts of this add 1 part of japan varnish; (3) asphaltum, Burgundy pitch, and beeswax melted together. The resist may either be melted and then brushed on, or the steel may be warmed so that on rubbing it with the resist the latter will melt and leave a thin film. The resist is allowed to become cold and hard, and is then drawn on with needles or, preferably, with a stick of steel of ⅛-in. diameter round or square section tapering to a fine point at each end; the weight of this tool is sufficient to penetrate and remove the resist as it is drawn along, thus leaving the hand more at liberty to draw freely or form letters as the case may be. If the steel is in the form of a plate, it now has a wall of wax built around its edges, and into the shallow dish thus formed the etching acid is poured. Knife blades and similar small articles having been properly coated with resist, may be dipped into the acid, or the latter may be applied to the portions to be etched by means of a camel-hair pencil or a stick, at the end of which is mounted a little ball of tissue-paper. Remember that all portions not covered with the resist will be etched. The etching acid may be any of the following mixtures. (1) Pyroligneous acid, nitric acid, and water; (2) diluted nitrous acid; (3) 2 oz. of copper sulphate, ½ oz. of alum, ½ oz. of salt, ½ pt. of vinegar, and 40 drops of nitric acid; (4) 4 parts of glacial acetic acid and 1 part of absolute alcohol; allow to remain for thirty minutes, and add gradually 1 part of nitric acid; (5) 1 part of fuming hydrochloric acid and 7 parts of water; add boiling solution of potassium chlorate and dilute with water. When the acid has bitten sufficiently deep, pour it off or remove it, and wash thoroughly in clean water. If it is required to etch more deeply certain portions, cover up the rest with a stopping ground of lampblack and Venice turpentine, or with any of the above etching grounds, and apply the acid again. When the etching is complete, wash off all traces of acid.

Dyeing Pampas Grass.—To dye pampas grass, place it in fairly strong solutions of aniline dyes, and heat until sufficiently coloured. The most suitable dyes are soluble blue, picric acid, fast yellow, eosine, magenta, methyl violet, malachite green, Bismarck brown, and acid brown. If, however, only small quantities are to be dyed, use Judson's or other dyes, which may be obtained in packets.

Mitreing Cornice Moulding.—In marking off the ends of two pieces of cornice moulding which are to be joined at right angles, the procedure is as follows. Let the section of the moulding be as shown in Fig. 1. Draw the plan of the mouldings and mitre as

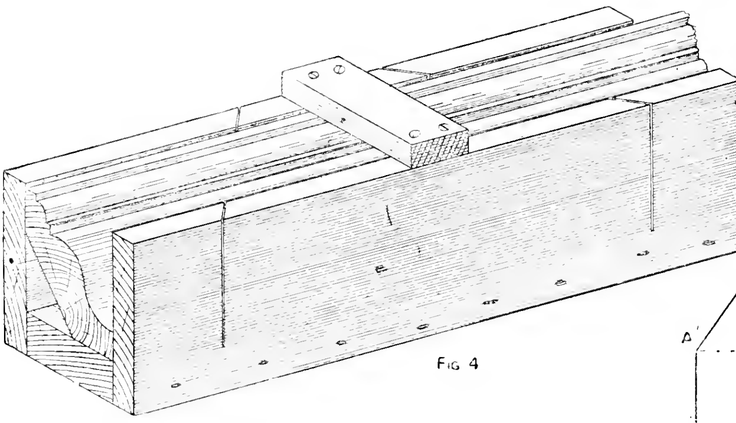


Fig 4

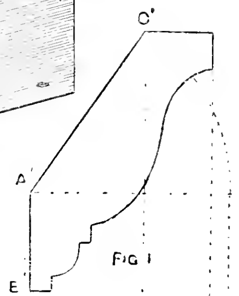


Fig 1

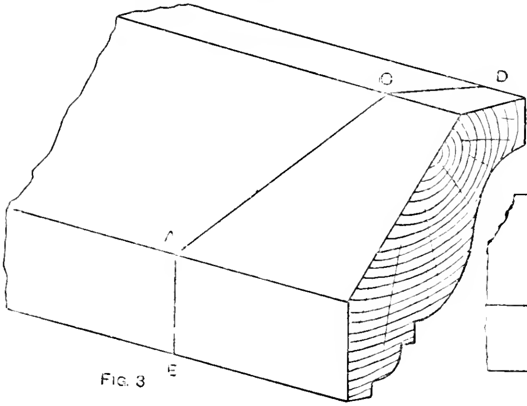


Fig. 3

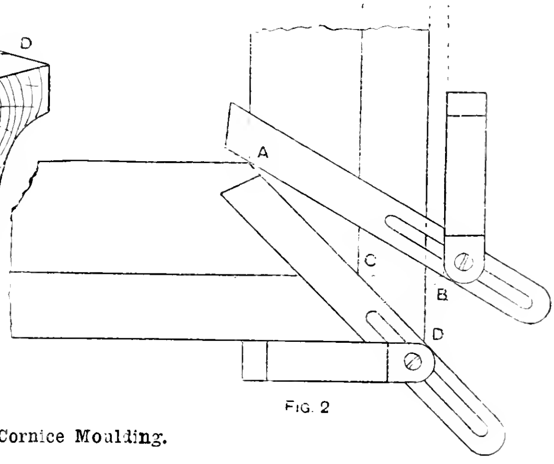


Fig. 2

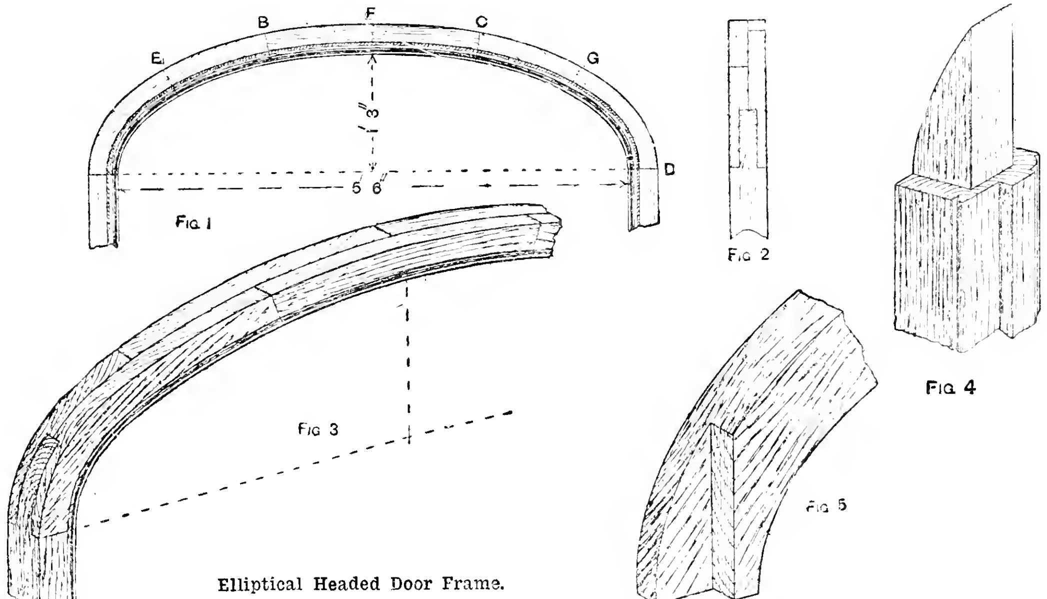
Mitreing Cornice Moulding.

at Fig. 2. Then set a bevel to the mitre line C D. This will be the bevel to apply to the top edge, as indicated by the line C D (Fig. 3). For the bevel for the sloping back, through the angle at A' (Fig. 1) draw A' B'. With A as centre and C' as radius, draw the arc C' B'. Now draw B' B parallel to the lines in the plan, as shown, and C B parallel to A' B'; then join B to A. Set the bevel as indicated, and apply it to the sloping back of the moulding and mark it. This will give a line as indicated by A C (Fig. 3). As A' E' is a vertical surface, the line A E indicated at Fig. 3 can be drawn square. This principle can be applied for mouldirgs meeting at any angle. If there are several mitres to be made and all meet at the same angle, a simpler plan, and one that will save much time, is to construct a mitre box which will hold the moulding to the exact angle, as shown at Fig. 4, and the mitres can be cut in the manner illustrated and described on p. 136.

Painting Railway Wagons.—The first or priming coat on railway wagons is made of tub white lead, raw linseed oil, patent driers, a little common black, and turpentine. The quantities may be best judged by experience, but the following will serve as a guide. Put 10 lb. of white lead, 1 qt. of raw linseed oil, and about ¼ lb. of patent driers in a large pot and mix well together, adding sufficient black to produce the desired tint. Strain through a piece of canvas and add just sufficient turps to make the paint work smoothly. The quantity of driers will vary according to the state of the surface to be painted and the quality of the material. The tint used must be made to accord with the finishing colour. For instance, if a light colour is desired, the priming and following coats must be light, so as gradually to lead to the finishing tint. For the second coat, the same colour may be used as for the first. For the third coat, oxide red, linseed oil, and terebine as a drier may be used. For the fourth coat, half oxide paint and half varnish may be used. For dead colours, the dry paint is ground in turpentine; a little gold size and varnish are then added and the paint thinned down to a working consistency with turps. Boiled oil may be used if desired with the finishing coats. It is necessary to remember, however, that only very small quantities of boiled oil should be used if the best results are to be gained in finishing. Either terebine or gold size may be used as driers with delicate tints such as would be injured by using patent driers. Copal varnish may be mixed with the finishing coats, or it may be used by itself as a finishing coat over the last coat of colour. The materials used will vary according to the finishing tint. For instance, a blue wagon would be finished as follows. The priming coat would be lead colour, rather dark, as described above; the second coat would be the same with a little blue mixed in; third coat, ultramarine or Prussian blue as a dead colour; fourth coat, the same, with half its bulk of varnish. The writing and picking out would then be put on with two coats of dead colour, the last coat being clear varnish. The usual practice is simply to paint with three coats of lead colour.

Blackening Aluminium.—The bronze known in the trade as "arsenic bronze," diluted with an equal quantity of water, is used for blackening aluminium. First the exposed parts of the surface should be curled, not straight-grained, with emery-paper; then the metal should be quickly dipped into the fluid and as sharply withdrawn, and drained. If on the first immersion the bronze has not taken well all over, the process should be repeated. If the preparation is too strong, there is a danger that the acid will eat away the metal. A recipe for arsenic bronze is hydrochloric acid, 12 lb.; sulphate of iron, 1 lb.; pure white arsenic, 1 lb. To this, for aluminium, must be added an equal quantity of water; and, when the metal has blackened, it should be dried in a mixture of blacklead and sawdust. Only sufficient sawdust is required to soak up the moisture. The exposed parts then may be lacquered.

Elliptical Headed Door Frame.—In commencing to set out and construct an elliptical headed door frame, width 5 ft. 6 in., rise 1 ft. 3 in. inside measurement, to be made in two thicknesses of 2½-in. and 2-in. stuff screwed together, first set out the head full size on a board as shown in Fig. 1. A mould should be made for half the inside thickness, and one for the outer thickness; from these moulds the stuff should be marked out. It will be seen from the drawing that the outer part of the head is made of three pieces—that is, from A to B, B to C, and C to D; the inside is constructed of four pieces—from A to E, E to F, F to G, and G to D. The direction of the grain for the outside pieces is indicated in the illustrations. The connection between the head pieces and the posts is fully shown by Figs. 2 to 5, as also the general construction of the head. It will be a stronger job if the pieces are glued as well as screwed together.



Elliptical Headed Door Frame.

Chemists' Show Bottles.—For an *amber-coloured* liquid for use in chemists' show bottles, dissolve 1 part of coarsely powdered dragon's blood in 4 parts of oil of vitriol, and dilute with cold distilled water. *Blue* liquid may be a diluted solution of (*a*) 1 oz. of copper sulphate in ¼ oz. of sulphuric acid, (*b*) soluble Prussian blue in oxalic acid, or (*c*) indigo in sulphuric acid. *Crimson* liquid is a diluted solution of 30 gr. each of iodide of potash and iodine in 1 dr. of water; or an infusion of 1 oz. of alkanet root in 20 oz. of turpentine. For *green*, (*a*) dissolve 1 dr. of copper sulphate and 30 gr. of bichromate of potash in 2 oz. of liquid ammonia, and add 1 gal. of water; (*b*) dissolve 2 oz. of copper sulphate and 4 oz. of sodium chloride in 1 pt. of water; (*c*) dissolve distilled verdigris in acetic acid and dilute with water; or (*d*) dissolve blue vitriol in water and add nitric acid until of the right tint. For *magenta*, dissolve acetate of rosaniline in water. *Orange-coloured* liquid is (*a*) a solution of bichromate of potash in water to which is then added a little sulphuric acid, or (*b*) a dilute solution of gamboge in liquor of potassa. For *pink*, add to a solution of cobalt nitrate or cobalt chloride sufficient sesquicarbonate of ammonia to dissolve the precipitate first formed. For *purple*, (*a*) mix a solution of 2 dr. of sulphate of copper in 2 oz. of water with a solution of 1 dr. of French gelatine in 2 oz. of boiling water, and add 2 pt. of liquor of potassa; shake a few times during ten hours, decant, and dilute with water; (*b*) dissolve 1 oz. of copper sulphate in 1 qt. of water, and add 1½ oz. of sesquicarbonate of ammonia; (*c*) add sufficient carbonate of ammonia to an infusion of logwood; (*d*) dissolve 3 oz. of lead acetate and 1 dr. of cochineal in sufficient water; or (*e*) add sulphate of indigo, nearly neutralised with chalk, to an infusion of cochineal. For *red*, (*a*) dissolve 10 gr. of sulphocyanide of potassium to 1 gal. of water, and add 10 drops of a solution of perchloride of iron; (*b*) dissolve carmine in ammonia and dilute with water; (*c*) dissolve cochineal in a weak solution of ammonia; (*d*) dissolve madder lake in sesquicarbonate of ammonia and dilute with water; or (*e*) dissolve cochineal in sal-ammoniac and dilute with water. For *violet*, mix together solutions of nitrate of cobalt and sesquicarbonate of ammonia, and add sufficient ammonio-sulphate of copper. For *yellow*, (*a*) dissolve 1 lb. of sesquioxide of iron in 2 qt. of hydrochloric acid, and dilute with water; (*b*) add a little alum to a strong decoction of French berries; (*c*) dissolve either the chromate or bichromate of potassium in water; or (*d*) dissolve equal parts of nitre and potassium chromate in water. *Multi-coloured* or *variegated* show bottles are formed by employing a number of liquids having different specific gravities and different colours. Pour in the following solutions in the order mentioned, using a funnel and allowing the stream to fall upon a floating cork. (1) Chemically pure sulphuric acid tinted blue with indigo sulphate, (2) chemically pure and untinted chloroform, (3) glycerine tinted brown with caramel (burnt sugar), (4) castor oil tinted red with alkanet root, (5) 10 per cent. alcohol tinted green with aniline colour, (6) cod liver oil containing 1 per cent. of oil of turpentine, and (7) 94 per cent. alcohol tinted with aniline violet.

Precautions in Making White French Polish.—To protect the shellac from atmospheric influences it should, when at the merchant's, be stored in water; neglect of this precaution causes the shellac to lose its nature, and it will not then dissolve by simple immersion. The lac, when purchased, should be at once broken up small, spread on clean paper, and set aside in a warm, not hot, place, and frequently turned over till it feels quite dry. It should then be placed with the spirit in a stone or earthenware pickle jar, over the top of which a piece of rag should be tied. Then set the jar in a saucepan partly filled with water, glue-pot fashion, and place in an oven or on a gas or oil stove, and gradually bring up to blood heat. If the lac does not then dissolve, it should be thrown away as worthless.

Polishing Curling Stones.—As a rule, curling stones are made of granite or trap, a mixture of felspar and hornblende; therefore to polish them without machinery is very laborious work. Rig up a vertical lathe similar to those used by lapidaries, and place the stone on it, and, while revolving, put coarse emery and water on it, pressing a piece of smooth iron on the stone as it revolves. When all pits and unevennesses are removed, carefully wash away the emery grains and go through the same process with fine emery, removing all scratches left by the former treatment. This process must be gone through with care, as if scratches are not removed it will be impossible to get a good polish. When an even grain, dull polish is obtained, carefully wash again, removing all traces of emery. Fasten a piece of felt to a piece of wood and on it put some putty powder slightly wetted, and apply to the stone until a good polish is obtained. A deal of the rough work might be done in bringing the stones into condition for further grinding if in the first instance they could be slung in front of a grindstone.

Vignetting Photographs.—If it is required to make a vignette photograph without showing much dark around the head and neck proceed thus. Cut in cardboard (old plate boxes answer well) a vignette considerably smaller than the desired vignette G (Figs. 1 and 2), and fix about ¾ in. from the negative by fastening with drawing pins. To do this, it may be necessary to nail some strips of wood B around the outer edges of the printing frame. Fig. 1 shows a perspective view and

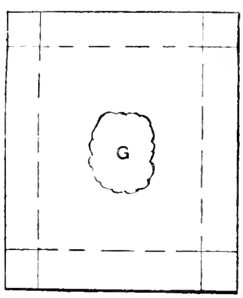


Fig. 1

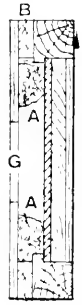


Fig. 2

Vignetting Photographs.

Fig. 2 a section of the vignetted frame. Cover with cotton-wool A any thin portions of the negative coming near the margins—such as may occur with a black coat—or the light will creep too far and the shape of the vignette be spoilt. The wool must be pulled out very loose and soft, or a hard line will be shown by the shadow it casts on the negative. In cases where the negative is very thin it is advisable to cover the vignette with tissue paper. Vignettes should always be printed in subdued light. A vignette card must not be cut too closely around the figure, nor its outline repeated too decidedly, as the effect thus obtained will be quite as inartistic as the stereotyped egg shaped patch. To produce a successful vignette, a light background must be used. With a dark background it is all but impossible to get a soft vignette. The farther the hole is from the plate and the darker the background of the negative, the larger will the vignette be, and the softer will be its outline. During early attempts at vignetting the print should be examined from time to time to see that the vignette is going on satisfactorily.

Straightening Brass Curtain Poles.—To straighten a brass curtain pole that has been used for a bay window, first anneal the tube where bent, then load it with lead and, after cooling, pass it through a hole in a firmly fixed bench until the shoulder of the bend rests against the shoulder of the hole. Then pull the tube until it is quite straight against the wood shoulder. Finally, melt out the lead and repolish and lacquer the tube. When lacquering the tube, first gently heat it, then apply with a brush an even coat of lacquer, and stand it aside free from dust until dry.

Making Taps for Watch Screw Threads.—Taps for watch screw threads may be made from needles, but probably they would not last long. A tap should be made from the best steel; therefore get a length of tool steel wire of the correct size. From this cut off a suitable length, say 1½ in. Soften it by heating to a dull red and allowing it to cool slowly. Hold it in a pin-vice and, resting it on a piece of boxwood, file it to a gentle taper until the end just enters the hole in a screw-plate; the wire may then be screwed into the latter, plenty of oil being used. When it goes hard, turn it back half a turn, then forward three-quarters of a turn, back half a turn again, and so on, advancing slowly until a full thread is cut for a sufficient distance. Then file three flats upon it for the whole length of the thread, tapering the flats to the end, where they should meet in a knife edge and show only half a full thread. Harden the tap by heating to a red colour and plunging in cold water. Brighten one flat and heat it over a flame until it is of a pale straw colour. This renders it less brittle, and is called "tempering." Then carefully smooth all three flats on an oilstone so as to leave good cutting edges. Finally, file some nicks in the soft end to indicate the number of the hole in the screw-plate to which it belongs.

Making a Wood Chuck in Sections.—A section chuck in wood, suitable for spinning a silver jug in the lathe, may be made in this way. Fix a piece of hornbeam of the requisite size on the mandrel and turn it to the shape of Fig. 1; A B is the height of the jug, C D the diameter at its

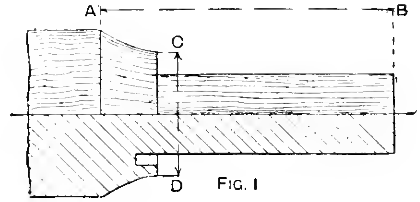


Fig. 1

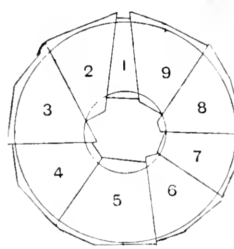


Fig. 2

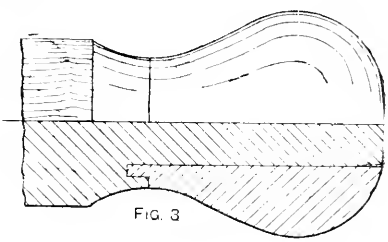


Fig. 3

Making a Wood Chuck in Sections.

narrowest point, and A C the profile of its upper part. The diameter of the long cylindrical part C B should be as large as possible without weakening the chuck. Next join a number of wedge-shaped pieces of hornbeam, as shown in Fig. 2; one of the wedges marked 1 should be so shaped that its broadest part turns away from the outside, while the opposite is the case with the other wedges. The joints must be perfect, and are best finished on their joining surfaces with a toothed plane, being so glued together that a piece of brown paper is inserted between each pair of wooden surfaces. Join 1, 2, 3, 4, and 5 together; next 6, 7, 8, and 9. It will now be seen that if the free surfaces of 1 and 5, and 6 and 9, are lying in one plane, the last joining will be fairly easy to accomplish. The better plan is to make a drawing, plan down the shape of the wedges, and work accordingly. When all are joined and dry, chuck the roughly cylindrical piece; bore it out, and turn a ring on one end which will fit nicely in the annular recess shown at D (Fig. 1), the cylindrical part C B fitting tightly in the hole bored without forcing the wedges from one another. When this is accomplished, the chuck can be finished to template as Fig. 3. Now separate the wedges, first marking them with lead pencil so as to secure their proper positions. Remove the loose part of the chuck, insert a thin knife blade in any of the glued joints, and tap gently with a mallet on the back of the knife. The wedges, owing to the brown paper inserted between them, can easily be separated: these nine wedges, when placed on the fixed part of the chuck in their proper rotation, will appear like one single piece. When the metal has been spun home and is removed from the lathe, it is evident that all the wedges are inside the bowl of the jug; but when this is released from the fixed part of the chuck, piece 1 (Fig. 2) can be pushed towards the centre and drops out, the other pieces following. Take care that none of the wedges are of larger transverse dimensions than will permit of them passing easily through the narrowest part of the jug's neck; a drawing of the sections should be made before joining them together.

Determining Grate Area, etc., of Vertical Boilers.—To determine the grate area of a vertical boiler, take the diameter of the firebox at the bottom of the firehole and obtain the area. For instance, in a boiler 6 ft. 6 in. high by 3 ft. diameter, the firebox at the bottom is 2 ft. 5¼ in. At the firebar level, however, this diameter is about 1¼ in. less, viz. 2 ft. 4 in. The area of circle of this diameter = 615·75 sq. in. = 4·27 sq. ft., which is the area of the grate. To obtain the approximate heating surface, multiply the grate area by 10, the ratio of heating surface to grate surface in these boilers being about 10 to 1. Thus, the heating surface in the boiler in question = 4·27 × 10 = 42·7 sq. ft. An approximate rule for the horse-power is to allow 10 sq. ft. of heating surface per horse-power.

Cutting Figured Boards from Pitch-pine Logs.—Some hints are given here on sawing up a pitch-pine log so as to get the best variety in the figuring of wood to be used for panels. It must be remembered that the amount of figure in a pitch-pine log depends on the amount of irregularity of growth in the tree. Curly figured pitch-pine cannot be got out of a plain pitch-pine log. But even the plainest log will afford a good amount of passable figure with judicious handling. In the accompanying illustrations, which treat only of plain logs, the outer board A (Fig. 1) will have a large and open figure, approximating to the type shown in Fig. 4, and so also would the outer boards on the three other sides of the same log. From A to B the figure narrows down considerably until when the position B is reached the amount and proportion of the figure will be approximately as shown in Fig. 5. The figure in all the boards will be symmetrical—that is to say, its climax, or turning point, will be at the centre of every board. All will, therefore, be suitable for panels. The symmetry of figure is due to the position of each board, relatively to the annual rings of the log. Each board is tangentially situated, the point of contact being near the centre of its width. Thus, the board C (Fig. 1), while inclined at a different angle to the boards A and B, will still have the same kind of figure on its face—for the reason that it is situated tangentially to the rings. Boards cut on the radii of the tree, as D and E (Fig. 2), will have no flower figure, and except for the presence of an occasional knot or two, perhaps, will have little of an ornamental character on their surfaces, excepting, of course, the straight or wavy lines that represent the edges of the yearly layers of wood (see Fig. 6). Here again the board F (Fig. 2) is disposed diagonally to D and E, but the figures will be the same, for all are situated on radii of the tree. To secure the greatest amount of figure out of any given log, it is therefore necessary to cut as many boards as possible tangentially to the rings. In Fig. 3, for example, each board will be ornamentally figured, and the width of the figure will be proportionate to the width of the board throughout. It is unfortunate that in securing this result the boards will vary so greatly in width. The sketch is given here only as an extreme example of a means to an end. In Fig. 2 the boards G and H are practically halves of the board A (Fig. 1), and the figure in these will therefore be like the upper and lower half respectively of the board shown in Fig. 4. From G and H, in towards E, the figure at the inner edges of the intermediate boards becomes less and less prominent, until when E is reached it is lost altogether, the board E being shown in Fig. 6. The reverses of figure shown at I, J, and K (Fig. 5) are due to slight bends that occurred in the growing tree—the saw, in its straight course, revealing outcrops of lower layers of wood. The figure on any given side of a log may also be varied within certain limits by first cutting a long wedge-shaped slab off the side and then making all subsequent boards parallel (in thickness) to the newly exposed surface. Closeness of ring will also affect the figure to some extent; but these circumstances do not interfere with the general principle just given.

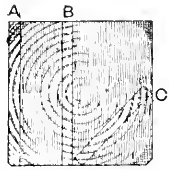


FIG. 1

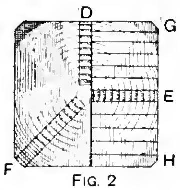


FIG. 2

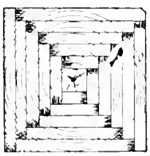


FIG. 3


FIG. 4

FIG. 5

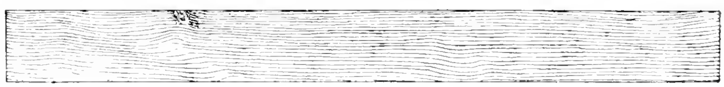


FIG. 6

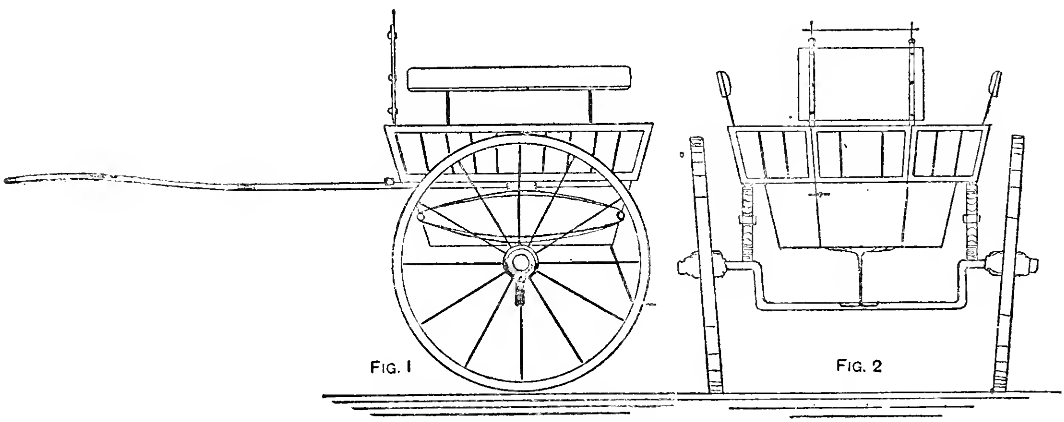
Cutting Figured Boards from Pitch-pine Logs.

Recipes for Bottle capping Mixtures or Waxes.—The following recipes are for waxes and mixtures for use in sealing bottles. (1) Soak 7 lb. of good gelatine in 10 oz. of glycerine and 60 oz. of water and heat over a water bath until dissolved; the mixture can be coloured by the addition of pigments, and various tints can be obtained by the use of aniline colours. The resulting compound should be stored in jars. To apply, heat the mass to a liquid and dip in it the cork and portions of the neck of the bottle; it sets very quickly. (2) Mix 1 oz. of gelatine, 1 oz. of gum arabic, and 20 gr. of boric acid with 14 fluid oz. of cold water. Stir occasionally until the gum is dissolved. Heat the mixture to boiling point, remove the scum, and strain. Then stir in a mixture of 1 oz. of starch and 2 fluid oz. of water until a uniform product results. As in the former recipe, the composition may be tinted with any suitable dye. Before using it must be softened by the application of heat. (3) Dissolve 3 oz. of shellac, 1½ oz. of Venice turpentine, and 72 gr. of boric acid in a mixture of 12½ fluid oz. of alcohol and 6 fluid drachms of ether, colour with a spirit-soluble dye, and add 3 oz. of powdered talcum. During use the mixture must be agitated frequently. (4) For a black bottle wax, melt together equal parts of common resin, pitch, and ivory black. (5) Another, melt together 20 lb. of common resin, 5 lb. of tallow, and 4 lb. of lampblack. (6) For a red bottle wax, mix together by the aid of heat 15 lb. of common resin, 4 lb. of tallow, and 5 lb. of red lead. (7) Melt together 6 oz. of resin, 2 oz. of shellac, and 2 oz. of Venice turpentine, and add 9 oz. of lampblack or other colouring matter. (8) Red: Melt together 6½ parts of resin, ½ part of beeswax, and 1½ parts of Venetian red or red lead. (9) Red: Use 4 oz. of shellac, 1 oz. Venetian turpentine, and 3 oz. vermilion. Melt the lac in a copper pan suspended over a clear charcoal fire, and pour the Venice turpentine slowly into it, finally adding the vermilion, stirring briskly the while. (10) Melt 2 lb. of shellac and 4 lb. of resin cautiously in a bright copper pan over a clear charcoal fire. When melted, add 2½ lb. of Venice turpentine and 1½ lb. of red-lead. Pour into moulds, or form sticks on a warm marble plate. Gloss may be produced by polishing the sticks with a rag until they are cold. (11) The following recipe is recommended by Sheirer: Heat 2 parts of Burgundy pitch until all the water is driven off, add 1 part of turpentine and 4 parts of colophony, and when the whole is liquid thoroughly mix it with 2 parts of chalk, ½ part of carbonate of magnesia, and 2 parts of Armenian bole.

Making Coloured Crayons.—Coloured crayons may be made by mixing pipeclay with water to form a stiff dough. The material may be made harder by adding a little soap to the water. For a blue colour, add common

ultramarine; for red, use venetian red; for brown, use umber or vandyke brown; and for black, use lampblack. After standing two or three days it may be made into balls, rolled into rods between two boards, then cut up into lengths and dried, first in the air and finally in a warm place.

Trap or Tub for 13-Hands Pony.—Fig. 1 is a side elevation and Fig. 2 a back elevation drawn to a scale of $\frac{3}{4}$ in. to 1 ft. of a tub or trap suitable for a 13-hands pony. The length on the seat is 3 ft. 3 in.; length of top rail, 3 ft. 9 in.; depth of well, 11 in.; depth above seat, 9 in.; length of bottom, 2 ft. 6 in.; width, 2 ft. $2\frac{1}{4}$ in. Greater sail is given to the sides so that the top of the vehicle is quite square. Walnut should be used for the well if to be finished in plain varnish. If the frame bottom be of ash, a pair of fence routers for rabbeting on sides and bottom will be required. Or the trap can be put together by rabbeting the ends and using 1-in. deal boards for the bottom, which can be nailed to battens running along the bottom of the sides. The seat boards are of birch 12 in. wide, screwed on top of the well; or the seats may be all framed together similar to the bottom. The four corner pillars and top rails are $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in. The sticks are of ash, $\frac{1}{2}$ in. square, finished black, the stained mahogany panels being screwed on inside. The wheels are 3 ft. 6 in.; stocks, $6\frac{1}{4}$ in. diameter by 7 in. long. Front hoop, 1 in. inside diameter by 2 in. wide; hind hoop, 5 in. diameter by 1 in. wide; spokes, $1\frac{1}{4}$ in.; felloes (cut from 2-in. ash plank) to finish about $1\frac{3}{4}$ in. square on thickest part; tyres, $1\frac{1}{4}$ in wide. The wings are 3 ft. 1 in. by $6\frac{1}{2}$ in. by $\frac{1}{2}$ in., and the raised backs 3 ft. 1 in. by 4 in. by 1 in. The wing irons should be fastened on underneath raised backs, and have 7 in. clearance of the wheels. The elliptic springs are 3 ft. 1 in. between centres of eyes and have five plates $1\frac{1}{2}$ in. wide. The shafts are fastened under the seats, and are 5 ft. 5 in. long in front of splinter bar, and 21 in. to 22 in. wide where the tug stops come about 15 in. from points. Breeching staples are 2 ft. from splinter bar, which is $1\frac{3}{4}$ in. wide by $1\frac{3}{4}$ in. deep, and let on tops of shafts $\frac{3}{4}$ in., clearing the front of the trap by an inch or so. The dash is 21 in. long and 12 in. high; axle, $1\frac{1}{4}$ in. at least with a 5-in. crank, and 3 ft. 7 in. between shoulders, clearing bottom of tub 9 in. The step is $10\frac{1}{2}$ in. long, 6 in. wide, and 5 in. broad. The door handle is of $3\frac{1}{2}$-in. plain brass. The door is 17 in. wide at the top and 15 in. at the bottom.



Trap for 13-Hands Pony.

The Manufacture of Nitrite of Soda.—The value of nitrite of soda in the improved methods of dyeing fabrics is increasing. Below is given a brief but authentic account of the manufacture of that chemical. The raw material, from which nitrite of soda is manufactured, is purified Chile saltpetre; the sodic chloride present in the latter lowers the value of the nitrite, but the elimination of the sodic chloride is an expensive operation not generally practised. The saltpetre is melted in large cast-iron vessels, and this involves the evaporation of the water and the decomposition of a part of the iodides and iodates which are in the saltpetre. The lead necessary for the decomposition of the saltpetre must be pure, as the presence of small quantities of other metals, especially of antimony, might cause the decrepitation of the whole charge. When the saltpetre, which melts at 310° C., has reached a temperature of 420° C., 14 parts of sheet lead are gradually added for every 5 parts of saltpetre, the whole being constantly stirred to obtain an intimate mixture. If the charge is too strongly heated the vessel might be pierced; if there appears a likelihood of the latter happening, add a quantity of cold saltpetre or withdraw the fire. Continue stirring after the lead has been added, and then, by means of a large cast-iron ladle, run the melted mass into cold water and assist the solution by constant stirring. The decomposition of the saltpetre by the lead at from 420° C. to 590° C. produces, besides the nitrite, about 1 per cent. of caustic soda, which dissolves some of the oxide of lead formed; to remove the latter, neutralise the solution with nitric acid. In this manner saltpetre is re-formed, the oxide of lead being precipitated as insoluble hydroxide. The neutralising may be effected either with nitrate of lead or with dilute sulphuric acid instead of nitric acid; of the two former, sulphuric acid is the cheaper, but by its use sulphate of soda is deposited in the concentrating vessels in the form of anhydrous salt. There are now in aqueous solution (1) nitrite, (2) undecomposed saltpetre, (3) caustic soda holding oxide of lead in solution, and (4) the soluble impurities of the saltpetre, such as chloride of sodium, etc. The insoluble residue which was precipitated consists of (1) oxide of lead, (2) a very small quantity of metallic lead which has escaped oxidation, and (3) peroxide of lead. The solution, diluted to from 6° B. to 8° B., is neutralised again with the same agent as was used before; the oxide of lead in solution is precipitated, and the neutralising agent is added as long as a precipitate will form. It may here be mentioned that it is commonly supposed, and most authors state, that nitrite of sodium has an alkaline reaction, but this is not the case, the pure nitrite being absolutely neutral. The neutralised solution is separated from the insoluble precipitate by any convenient method, and is then concentrated in cast-iron pans until it has a density of from 42° B. to 45° B. when warm. The insoluble precipitated residue is thrown upon a large filter of coarse sacking, where it is washed with warm water and the wash waters are added to the principal solution. The concentrated solutions are mixed together in cast-iron vats and left to crystallise; if the crystals thus obtained are not pure, they must be re-dissolved and re-crystallised. The pure crystals are separated in a centrifugal machine, washed, and dried. The desiccation takes place in an oven at a temperature of about 50° C., and the crystals are packed in parchment-paper cylinders of double thickness. The residuary oxide of lead may be melted and cast as it is, reduced to the metallic state, or transformed into minium, a heavy, brilliant red pigment which is used as a cement and paint, and in the manufacture of flint glass. The lead oxide can also be used in the preparation of white lead, of lead nitrate, lead acetate, and other plumbic compounds.

How to Produce Red Letters on Glass.—Red letters are produced on glass by a sand-blast process. The glass used for this purpose is known as ruby flashed glass. The letters that are to be produced are first cut out in paper. These paper letters are coated with a resist or protective covering composed of 1 part of ordinary hot glue and 1 part of glycerine, mixed together. The letters are then pasted on the glass, the resist side outwards, and the glass is then ready for blasting. The sand cuts away the unprotected surface of the glass, the resist protects the paper letters, and, when these are washed off the glass, red transparent letters will be shown on a white opaque ground.

Preparing Tannic Acid.—An impure tannic acid may be obtained from myrobalans (a dried astringent fruit resembling a prune) by grinding them and extracting in a boiler containing hot water; the liquid may be strained and evaporated to dryness, yielding a dry extract which is suitable for dyeing or tanning purposes. A concentrated fluid extract is often made by partial evaporation. To obtain a pure tannic acid, it would be necessary to treat the myrobalans in the same way as nutgalls, *i.e.* extract by percolating a mixture of alcohol and ether through the powder. The percolate will separate into two layers: the lower one is a watery layer containing the tannin, the upper layer contains the alcohol and ether, with colouring matter, etc. The alcohol and ether can be recovered largely by distillation; the watery layer is evaporated to dryness, and yields the pure acid.

Removing Stains from Linen.—Tea and fruit stains are removed from linen by steeping the latter in a chloride of lime solution (about $\frac{1}{4}$ lb. to 1 gal. of water), or preferably in hypochlorite of soda, which may be made by treating $\frac{1}{2}$ lb. of chloride of lime with $\frac{1}{2}$ gal. of water, dissolving $\frac{3}{4}$ lb. of washing soda in $\frac{1}{2}$ gal. of water, and mixing the two solutions. The solution should be allowed to remain till clear, the liquid, which is poured off from the deposit, being used for bleaching.

Making French Cork Boot.—In fitting the second insole of a French cork boot where a box and rand are sewn in, last the boot in the ordinary way, taking care that the feather is nice and even, and that there is a good innersole to work upon. For the box, a piece of first cut is cut the required length, say from 12 in. to 14 in., and about $\frac{3}{8}$ in. wide. Mark a line, as A B (Fig. 1), on the grain side of the leather, $\frac{1}{4}$ in. from the edge, and cut it through a little way, then serve the reverse side in a similar manner, as at C. The leather should be damped, and the cuts made larger with a channel opener, a welt plough or knife being used to cut a thin strip of grain from the narrow side as at D. Or the box can be worked with one bevel edge (see E, Fig. 2). Instead of sewing in a welt, the box can be sewn in, and in doing this the awl will go in at A (Fig. 1) and come out at C. The piece taken out at D will admit of the box lying close to the upper, while the channel at C allows the stitch to sink in. If a box like Fig. 2 is used, the awl should go in at the dotted line on the bevel edge E and come out at F. This is also shown by the dotted lines G and H in Fig. 3, which is a transverse section of nearly the whole of the middle portion of the boot. Thus the awl goes in the innersole at J just as for a welt. When the box is sewn in all round, it can be gently hammered down, trimmed, and ironed up, as shown by the dotted line K. The welt, as shown at L (Fig. 3), is sewn in as follows:—starting at the heel, sew up the waist to where it meets the box. Between these stitches put the awl under each loop, letting it grip the innersole and come out on the top of the box, thus sewing in the welt, and on to this the sole will be stitched as at M, N. A very thin layer of felt is put in, and the remainder filled up with sheet cork, excepting another thin layer of felt to keep the boot from creaking when the outer sole is put on.

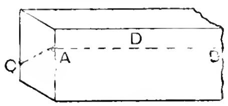


FIG 1

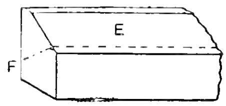


FIG. 2

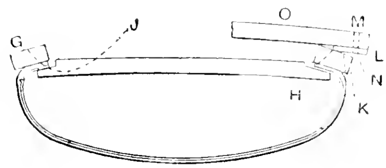


FIG. 3

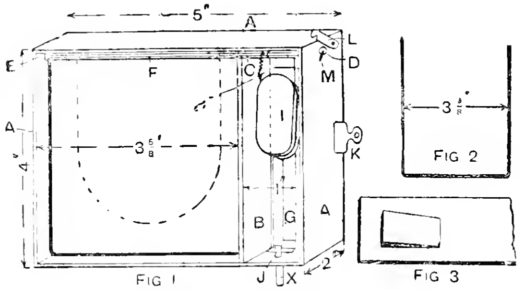
Making French Cork Boot.

Varnishing a Carriage in the Wood.—It is assumed that the vehicle to be varnished is made of four differently coloured woods—ash, creamy white; mahogany, reddish brown; hickory, flesh-coloured drab; and lancewood, straw colour. The straw colour of lancewood contrasts best with mahogany, so the two other light-coloured woods have to be tinted to match straw colour. For this purpose coat with a solution of gamboge and turpentine, a few drops of linseed oil being added to every pint of the stain; test on any odd bits of ash and hickory to make sure the stain is of the right tint. Prepared yellow stains might be diluted to answer the purpose. The staining does away with the patchwork look of the several light-coloured woods. The next process is to fill the wood grain. The dense lancewood will not need so much filling as the other woods. The filling is a nearly colourless liquid made by mixing together 2 parts of turpentine and 1 part of palest linseed oil; apply it with a stumpy-haired brush, and wipe off any superfluity with a clean white rag, rubbing the latter well into the wood to smooth the grain which the liquid filling has raised. After a day or so, brush in another filling. Make this with 2 parts of linseed oil and 1 part of turpentine, and add a tablespoonful of sugar of lead or of sulphate of copper driers to every pint of filling; the lead does not affect the colour of the filling so much as the sulphate of copper. Wipe with rag as before, and allow to stand for a day or two. If the weather makes the oil sweat out on the surface, wipe it thoroughly dry and then well brush on a light coat of pale copal varnish, following in a day or two with a finishing coat of hard-drying copal varnish. The surface of the first coat of varnish may be rubbed over with a bunch of clean horsehair to remove nibs and to grain it slightly; this dulness favours absorption of the next coat of varnish, which is a full flowing coat lightly laid on. Among the points it is necessary to remember are these. Do not let the varnish flow into recesses; let there be at all parts only the amount of varnish laid on with the brush; and always hold a small dry tool in the left hand with which to wipe off superfluous varnish. The ironwork, if quite bright, may be varnished with carriage copal varnish in which a little white lead, thinned with turpentine, has been mixed (a tablespoonful to 1 pt. of varnish). The ironwork must be free from grease or oil before it is varnished, or it will dry unevenly. Black japan is used for common work such as Ralli cars, but it does not harmonise with other colours. Leather, if used for dash-iron or wings, should be red-tan enamelled, or japan surface leather should be used; either of the leathers mentioned is more suitable than black leather for the purpose.

Gypsum, or Plaster-of-Paris.—Plaster-of-Paris, or gypsum, is a sulphate of lime found at places in Cheshire, Cumberland, Derbyshire, and Oxfordshire, in England, and at many places in the neighbourhood of Paris, France, hence one of the names given to it. It is also found in Germany, Switzerland, Italy, Spain, and North America. According to Burnell, it occurs "either in contemporary strata of great thickness (as near Paris) in the tertiary formations; or in the iridescent marls of La Meuse, or the Aveyron; or in masses of a subsequent date in different secondary rocks." The latter kind, being generally in contact with igneous rocks, is associated frequently with the dolomites, rocksalt, bitumen, and sulphur. The better qualities of gypsum have almost the hardness of calcareous stones, but after the evaporation of the water of crystallisation by burning they are easily powdered. On being moistened with water gypsum reassumes the hydrate form it possessed before it was burnt, and it crystallises on and around the substances between which it is placed, recovering its original density and strength. It is for this reason that gypsum is so extensively used in building. Gypsum is quarried underground and in the open either by cutting with picks and wedges or by blasting with explosives. The gypsum stone is broken up fairly fine and conveyed to the kilns, which are primitive structures, consisting of three brick walls supporting a tiled roof in which are openings to allow the escape of steam; one side of the kiln, which really is but a shed, is open. The gypsum is piled up in the form of arches, the larger stones being at the bottom, near the fireplace formed by the vaults of the arches. In the latter a wood fire is lighted, the flames rising through the crevices left between the stones. A greater heat than 200° C. over-calcines the gypsum, which then loses its power of combining with the water and reassuming its hydrous sulphate form. A better kiln than the shed form is that with its chimney passing round and round the gypsum, which thus does not come in contact with the smoke or fuel; the latter in the ruder form of kiln discolours the calcined article. Perhaps a still better method is the one in which advantage is taken of the fact that steam at very high temperatures is a gas possessing great affinity for water. The finely broken gypsum is subjected to the action of steam of the temperature of 205° C., and a pure anhydrous sulphate of lime is produced. The calcined gypsum is powdered in a mill, and is then ready for use. It is necessary to pack it very carefully, as in contact with a damp atmosphere it will rapidly spoil.

Recipes for Pottery Glaze.—Different clays have different shrinkage, require different firing, or stand a greater or less degree of temperature, hence the glaze is a matter of trial. Glazes are coloured by admixture of small quantities of metallic oxides. Common clay vessels are painted over with red-lead, but this glaze is dangerous, as it is affected by acids. Borax will make a glaze, and is used as a flux. A white earthenware glaze may be made from Cornish stone 35 parts, borax 20, crystals of soda 10, red-lead 20, and blue calx $\frac{1}{4}$ part. Calcine and pulverise and grind with 20 lb. of white-lead, 10 lb. of Cornish stone, and 5 lb. of flint.

How to Make a Silent Camera Shutter.—A noiseless shutter that works inside the camera and that will give any length of exposure is made as described below. Being perfectly noiseless, they are particularly suitable when photographing children and animals. Exposures as brief as a quarter of a second may be given, which is generally sufficiently quick for such work. Construct a box A (Fig. 1) of the dimensions shown, dividing it 1 in. from the end with a strip of the same width B, having a slot C. Through this slot and also the holes D and E previously made in the framework a roller F, about $\frac{3}{8}$ in. in diameter, is passed (a wooden knitting-needle answers well). In this roller burn two holes $3\frac{1}{2}$ in. apart, and into them fix the wire frame shown in Fig. 2 so that it hangs flat. Now cover rod and frame with thin velvet, gluing to the rod and sewing over the frame. Make a frame $\frac{1}{2}$ in. wide and $1\frac{1}{2}$ in. deep to fit the left-hand compartment, as shown by dotted lines. This frame is afterwards covered on its inner edge with velvet, making a light-tight join. Around the roller F glue one end of a strip of tape, 2 in. long, and wind the remainder around free, joining the loose end to a strip of wood G, about 3 in. long. G is hinged to the bottom with a small piece of tape also. Next wind some



How to Make a Silent Camera Shutter.

fine wire around a small rod to form the spring H, and fasten to this roller and the side of the framework as shown. If now the strip G is forced down, the roller is pulled round and the flap opens, but is pulled back by the spring directly G is released. For this purpose an india-rubber bellows I on a tube is fitted at J. It only remains to fit a strip across the right-hand compartment with, perhaps, a wedge-shaped block (as in Fig. 3) to give extra pressure to the bellows. A couple of bent plates K, one at each side, are for attaching to the camera front. The tube J projects for the pneumatic release at X. This should be fitted with a tap to keep the shutter open while focussing. The catch L and the pin M are used for the same purpose, or when long exposures are necessary and a cap must be used.

Varnishing Violin.—In preparing a violin for varnishing, commence by sandpapering it all over with No. 1 paper and freeing it from scratches. Go over the entire surface lightly with a clean, slightly damp sponge, and when the wood is dry it will be quite rough again; rub with No. 0 paper till smooth, and repeat the damping and papering until a dead smooth surface is obtained, quite free from scratches. It is not usual to stain violins, as a much finer effect is got by incorporating the colour with the varnish. The following process will give excellent results. Dilute 4 parts of good copal varnish with 1 part (by measure) of turpentine, and heat it quite hot, being careful not to let it catch fire. Go over the entire violin with this with a stiff brush, and rub in as much as it will take at one coat; this will not be much if the wood was well finished. When it is quite filled, make a pad of cotton-wool, done up in a fine cotton or linen rag, moisten this with turpentine, and clean the surfaces of the violin as rapidly as possible; then put on a coat of spirit varnish, made thus: Colour $\frac{1}{2}$ pt. of methylated spirit with turmeric and red sanders wood. In another $\frac{1}{2}$ pt. of methylated spirit dissolve 2 oz. of gum sandarach (juniper gum). Mix the two together, add two tablespoonfuls of Venice turpentine and 2 oz. of white shellac, and when dissolved, filter through cotton-wool or fine muslin. This elastic spirit varnish gives the violin the warm amber colour so much sought for. Lay on the varnish carefully with a large, round, camel-hair brush, avoiding streaks, and not going twice over the same place. It will dry very quickly, and three or four coats may be put on daily till the desired colour is reached; rub down with finely sifted pumice-powder and water and a woollen rag after every third coat. When a good body of varnish is on, the surface must be rubbed down with the pumice-powder till it is dull and smooth all over; the pumice is then thoroughly washed of. The final polish is obtained with tripoli and water, or crocus and linseed oil, on a rag, as before. After this is cleaned off, a brisk rub with the heel of the hand will give a surface like glass. The above instructions are applicable also to re-varnishing an old violin; but then it is necessary, in the preliminary sandpapering process, entirely to remove all traces of the old varnish. When that has been done, the work is identical with the above.

Coloured Printing Inks.—Printing ink is not usually made satisfactorily in the absence of big plant, but below are given some simple instructions easily followed. Into a 5-gal. iron pot pour 6 qt. of old linseed oil, and heat gradually over a fire to boiling point. As soon as the vapours that arise from the surface will catch fire when a light is applied, remove the pot from the fire and allow the oil to burn for a time; smother the flame by placing the lid over the pot. If the oil has thickened sufficiently, it will draw out into threads $\frac{1}{4}$ in. long when dropped on a cold surface. If the oil is not thick enough, relight it, and allow it to burn down. If the oil is all right, stir till the frothing ceases, and put in gradually 6 lb. of crumbled amber resin, and keep stirring till all is melted. Then stir in $1\frac{3}{4}$ lb. of sliced curd-soap, and when the frothing has ceased, place it on the fire, and bring to boiling point, stirring well all the time. This is printers' varnish. Varnish is best made out of doors; it smells unpleasant in boiling, and there is less risk of fire out of doors. To make brown ink, add varnish to a powdered mixture of 2 oz. of burnt umber and 1 oz. of rose pink, and grind till smooth with a muller. Indian red and Venetian red, toned with a very little lampblack, also give browns. A fine black ink may be made with 9 oz. of balsam of copaiba, 3 oz. of lampblack, $1\frac{1}{2}$ oz. of indigo or Prussian blue, or $\frac{3}{4}$ oz. of each, $\frac{3}{4}$ oz. of Indian red, and 3 oz. of dry turpentine soap. These are to be ground with the varnish till quite smooth with pestle and mortar or a muller and slab. For black varnish ink, 5 oz. of Prussian blue or indigo, or $2\frac{1}{2}$ oz. of each, 4 lb. of mineral lampblack, and $3\frac{1}{2}$ lb. of good lampblack, are mixed with warm varnish, and the whole is well ground on a slab with a muller.

Primary and Principal Colours.—There are three primary colours—red, yellow, and blue; the ten principal colours are Chinese white or baryta white, yellow ochre, Naples yellow, vermilion, Indian red, madder carmine, emerald green, ultramarine, Prussian blue, and ivory black or Indian ink.

Electro-brassing Solution. — For a solution for electro-brassing small iron goods, dissolve 1 lb. of good yellow sheet brass in sufficient warm dilute nitric acid to dissolve the brass without leaving any free acid; then add the whole to 8 gal. of rainwater. Now add liquor ammonia until the brass solution assumes a deep blue tint, then add a solution of cyanide of potassium until all the blue tint disappears. Filter through calico and add an equal bulk of rainwater to form the brassing bath. This must be worked with an anode of good yellow sheet brass, which should dissolve freely to maintain the solution in good working order. To obtain a uniform bright yellow deposit of brass on small iron goods held in baskets, some skill will be required, as the character of the deposit is influenced by the temperature of the solution, the density of the current, the proportions of metals, the size of the anodes, and the movement of the articles being plated. Very thick deposits of brass might be dipped in acid to improve their colour; it is not safe to dip thin ones.

Glazing Terra-cotta Tiles.—A glaze for terra-cotta tiles requiring only a moderate heat can be made from a solution of sugar of lead in hot water. Cover the tiles with the solution and expose to a clear red heat. A coke fire would probably be suitable, provided it does not touch the tiles in any way. A sagger, or receptacle, to hold the tiles may be made from a drain pipe. Limewash the inside of the pipe and set the tiles with the glazed surfaces facing each other. Try immersing them in salt or borax, and then bake or paint over with red-lead; this will give a deep red glaze.

Repairing Marble Clock Case.—To repair a broken corner of a marble clock case to imitate grain, which is light green, white, and black, a hard-setting cement can be used which is made by mixing plaster-of-Paris with white of egg. This can be used for re-forming the broken corners, and afterwards painted black and gently rubbed with furniture polish.

Gum Bichromate Process of Photography.—The gum bichromate process of photography is an old process, and is only suitable for large work, and for subjects that do not need much definition. The process itself is as follows. Cut some sheets of good cartridge paper into pieces rather larger than the negative to be printed from. Prepare a 10 per cent. solution of potassium bichromate and in it immerse the cut paper for from two to three minutes, taking care that the paper is evenly wetted. The immersion may be done in ordinary daylight, as the paper does not become sensitive until it is dry. In a room free from dust pin up the paper by the corners to dry. As soon as the paper is dry it must be kept in the dark, or as carefully guarded from actinic light as silver paper would be. Make up a 40 per cent. solution of gum arabic and filter and mix with it the pigment that is to be used, which would be either ordinary powder colours as obtained from the oilshop, or the water colours sold by artists' colourmen. The latter colours are preferable, as they are usually in a finer state of division. A thin coating of the mixture is then evenly applied to the paper, smoothing out with a large badger brush; dry thoroughly. The exposure may be timed by an actinometer, but is practically a trifle longer than would be required to make a print in albumen from a negative of similar density. Lay the print face downwards in cold water for half an hour and note the result. If correctly exposed there will probably be by this time a dim outline of the principal objects. Raise the temperature of the water and bathe very gently until the image is well out. Soak for a few minutes in alum and rinse well to remove the bichromate; this is all the fixing required. The paper should not be kept long after sensitising. Some examples of the gum process have been obtained by working up the softened gum with a brush. Carbon tissue allows of similar modifications.

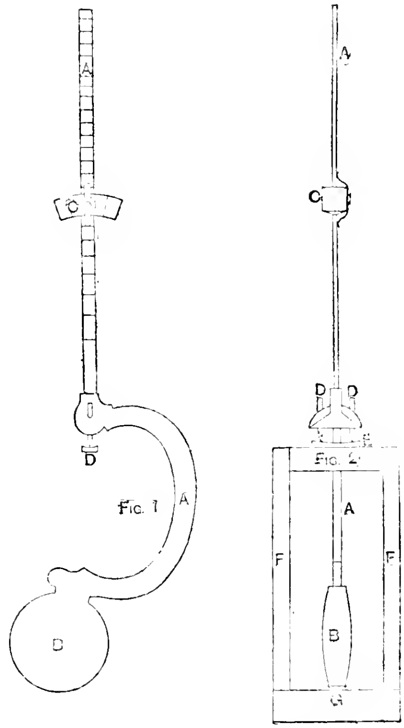
Determining Contents of Rectangular Tank.—To determine how many gallons of water would be held by a tank of specified dimensions, first find the contents in cubic feet, and then multiply by 6·23. The contents of a rectangular tank 6 ft. by 9 ft. by 4 ft. 6 in., equals $6 \times 9 \times 4\frac{1}{2} = 243$ cub. ft., so that the water contained should measure $243 \times 6{\cdot}23 = 1{,}514$ gal. (approximately).

Making a Theatrical Bald Wig.—In making a bald wig such as is worn on the theatrical stage, a piece of stout calico should be tightly stretched over a suitable dummy, which is generally a wooden block, and the calico should be tied or tacked round the neck of the dummy. Give the calico a coat of hot jelly size, which should be followed by two coats of flake white. The medium for applying the colour should consist of copal varnish, linseed oil, turps, and a few drops of gold size. Each coat must be dry and hard before the next is applied. The flesh tints may be obtained by mixing small quantities of rose madder and Indian yellow with flake white, the medium being the same as before.

Simple Metronomes.—A metronome, a device for measuring and beating time in music, may be made with a piece of tape and a weight, or it may be an elaborate clockwork arrangement. For the tape and weight metronome, the distances from the centre of the weight to the point of suspension should be as follow:—

No. of Beats per Minute.	*Distance in Inches.*
65	39·14
70	28·75
80	22·01
84	19·87
86	19·01
90	17·39
100	14·69
105	12·88
110	11·64
120	9·78
126	8·87
130	8·34

Slightly more advanced than the weighted tape in suspension is the metronome illustrated by Figs. 1 and 2. It is, however, of simple construction though it will answer quite as well as a more elaborate arrangement. Of the compound pendulum, A is the rod, B the bob, and C a small supplementary weight which slides up and down the upper part of the rod. With C at the top end the pendulum, on being set in motion, will swing for twenty minutes or more at the rate of about forty-eight beats to the minute; when C is at the bottom end, near the pivots, the pendulum will swing for a shorter time at the rate of about 144 to the minute. These matters having been determined by experiment, the intermediate speeds are measured off on the rod; the divisions are closer together as they approach the top, as shown at Fig. 1. The pendulum should be cast in brass, and only the top part of the rod, on which the weight is to slide, need be filed to $\frac{3}{16}$ in. in breadth and $\frac{1}{16}$ in. in thickness. The pivots are shown at D (Figs. 1 and 2); they are two pins of tempered steel filed to a sharp point and driven tightly into holes drilled through the projections on the sides of the rod as shown in Fig. 2. The points work on a smooth piece of brass E (Fig. 2) which is slightly hollowed out on its top side in both directions for the purpose of enabling the pendulum to swing itself perpendicular when set up on an uneven surface. A small steel spring is screwed on one side of the weight C to keep the latter at any desired height, though it allows the weight to be slid easily up and down the rod when required. The bob



A Simple Metronome.

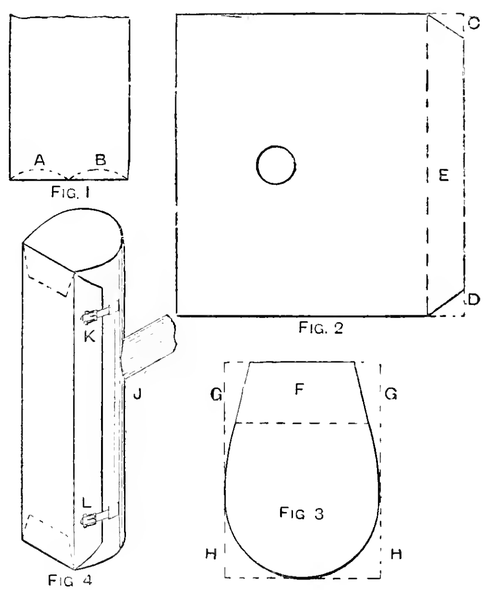
B is placed slightly off the centre (to the left) to compensate for the weight of the bend on the right. The stand has a mahogany base G (Fig. 2) 3 in. by 2 in. by ½ in., with two uprights F 5½ in. by ¾ in. by ¼ in., and a cross-bar to support the brass plate E.

Cutting Tiles.—A white glazed tile may be cut into two pieces by laying it flat on a soft wood board and cutting very carefully with a chisel. To reduce the size of a tile, or to take an irregular-shaped piece out of it, break or pinch off pieces with a pair of pincers of about 7-in. size. The edges can be rubbed down on a stone if required to be very neat.

Cleaning Furs.—These are methods of cleaning furs. (*a*) Rub with *hot* roasted bran, allowing the bran to enter the fur well. Then shake the fur and well brush. (*b*) Moisten bran with hot water and well rub it into the fur with a piece of clean flannel. Now take some dry bran and a clean dry flannel and rub this well in until the wet bran and the fur have become dry. To remove the bran, give the fur a good shake, a sharp but light beating with a cane, and brush with a soft brush. (*c*) Mix and heat in an oven equal parts of flour and fine salt, and thoroughly rub the hot mixture into the roots of the fur. Now well shake the fur, then throw it over the back of a chair, fur side upwards, and brush out any of the mixture left, using the end of a soft brush, and giving sharp "dabs" so as to get to the bottom of the channel formed by the parting of the fur, blowing well all the time.

The Manufacture of Water Colours.—Cake and moist water colours are made by grinding the dry pigments in a mill with gum water and a little glycerine or honey to prevent them becoming too brittle; the pasty material is rolled out and cut into squares, partly dried, and then pressed in moulds or placed in tins. For the moist colours more gum water is used than for the cakes. The gum water is made by dissolving purest gum arabic in twice its weight of water and straining through muslin, then adding a little glycerine and a few drops of oil of cloves. Very little glycerine must be used or the colours will tend to absorb moisture from the air and fade or become bad.

Making Leather Case for Croquet Mallet.—The leather for a croquet mallet case need not be very stout, but it must not be flimsy, unless it is backed with something, or it will wring in the sewing, and the handle portion will be unsightly. The leather used for the straps of bags, etc., will be suitable. Before cutting the leather, cut from stout cartridge paper a pattern to the shape of the mallet. Fig. 1 is the cover for the handle, which is 3 ft. long and 5 in. wide; Fig. 2 shows the cover for the mallet, which is $12\frac{1}{2}$ in. long by 13 in. wide; while Fig. 3 is a



Making Leather Case for Croquet Mallet.

pattern for the two ends, which is $3\frac{1}{4}$ in. wide by $4\frac{1}{2}$ in. deep. Two small arcs are cut out of Fig. 1, as A, B, so as to fit a hole $1\frac{5}{8}$ in. diameter cut in Fig. 2 after it is curved to the outline of Fig. 3. In Fig. 2, $1\frac{1}{2}$ in. is marked off at one side and the two corners are cut off, as C and D. The circular hole is then cut out, the centre being about $4\frac{1}{4}$ in. from the left-hand side, so as to be in the centre of the case when finished. In Fig. 3, 1 in. is allowed on top for a lap. The pieces E and F (Figs. 2 and 3) will form themselves into flaps if a piece is grooved out along the dotted line. To get the piece, Fig. 3, a good shape, cut an oblong piece to the measurements given above and fold it down the centre, and then cut off the corners G and H. Fig. 1 is now sewn into cylindrical form so as to take the handle, the circular piece, $1\frac{5}{8}$ in. diameter, as cut out of Fig. 2, being sewn to one end, the other end, with curves A and B (Fig. 1), being fitted into the socket hole at J (Fig. 4), and the straps and buckles sewn on at K and L. To give a good appearance to the case when finished, a little plush may be fixed in with glue paste; if desired, a cheaper lining can be used.

Notes on Re-painting a House.—In commencing to re-paint a house, begin in the upper rooms, first washing off the ceilings, then stripping off the paper from the walls by applying water just where it is wanted, allowing sufficient time for it to soak, and removing a piece at a time. If a little soda or lime has been put in the water so as to more easily remove the paper, wash the work with dilute caustic soda. Contagious matter and certain insects are frequently retained in the paper, and the caustic soda acts as a disinfectant. Repair the bad places with plaster and whiting; and it is sometimes desirable to coat with size to stop suction, and to put on lining-paper to make a sound job and hold the plaster together. The next job is to clearcole the ceiling. Put some whiting in a pail, cover with water till the lime in the whiting is slaked, pour off the water, and thoroughly mix in some hot size and add colour at the same time, if the ceiling is to be coloured, or a little black if the ceiling is to be quite white. The black removes the yellow tone or raw appearance of the white. Strain the colour through canvas before using. The first coat for the ceiling is used thin and hot; the second is used with the chilled colour, so that it will go on thick. Do not lay the colour off, as in oil-painting, but put it on with short strokes, in varying directions, so that the light from the windows will not catch the lines likely to be made by strokes of the brush. The distemper has to be put on full, as contrasted with oil-colour, which has to be spread. When the ceiling and walls have been repaired, and the ceiling coloured, the paintwork is washed and rubbed with pumice-stone and soda-water, bad places being afterwards filled up with putty. Sometimes panels have to be filled up with distemper, and rubbed down with a flat cork covered with glasspaper. This latter is hard work if there was too much size in the distemper. When the filling-up has been brought to a surface, it should have a coat of paint, which should be nearly all oil. Door frames, window frames and sashes, and all wood mouldings, should have their corners scraped and brushed out. The mantelpieces should be well washed with strong soda- and lime-water, which should be kept on for a time so that it may penetrate. The mantelpieces can then be washed off with clean water and allowed to dry. Having got the woodwork to a fairly level face, coat it with colour. Colour the door frames first, and then the edges and panels of the door. After laying off the latter, commence the rest of the door at the middle upright stiles, afterwards doing the cross stiles. Finish by squaring off the two outside stiles, always remembering that the object is so to put on colour that an even smooth surface is obtained quickly. Be careful of the glasspaper, and bear in mind that its purpose is to make smooth, not to take off paint. Also remember that a brush mark in the first coat will show in the last one. Commence priming and painting at the right-hand corner of the house, doors, rooms, and windows, working to the left all through the house. If convenient, leave the staircase to the last, previous to preparing the skirting, for which sienna is the best pigment, as it does not show the damage as much as other colours. The staircase stringing may be painted plain, coloured, or it may be grained and varnished. If the outside doors are much cracked or blistered, the old paint must be removed. This may be done by brushing on a solution of 2 lb. of washing soda in 3 gal. of water, thickened with lime dissolved in hot water. When softened, the paint is scraped off, or, instead, the paint may be burnt off with a flame. The flame is the better method, as the soda-water may leave moisture, which is the cause of blisters. In painting street doors, precautions should be taken against subsequent blistering. On this account, it is wiser not to use water or any stripping material whatever on the door, but to burn off the paint with flame. Keep the brushes in oil overnight—not in water. Of course oil, as far as possible, should be kept out of the colour, as that, as well as water, will cause blistering under the action of the sun. In preparing the front of a house for repainting, begin at the right-hand side, and clean out the spouting, windows, etc.; continue in the same way to the bottom, rubbing downwards. Commence painting at the spouting, window sashes, and panes. Then work down the front with a coat of priming, taking doors and shutters in due course. For a black and dirty compo. front, it is best to stain the lead with black to a light grey, as the next coat will give it a solid appearance. In mixing colour for outdoor work, use principally or wholly boiled oil, unless it be for decorative parts of the house, when the ordinary method may be employed. The compo. front may be repaired in places if necessary with Parian cement, as this can be smoothed off and painted immediately.

Preparation of Selenium.—Selenium is a non-metallic element with properties somewhat like sulphur. Selenium in combination with oxygen forms several acids, but cannot be said to form salts like those of metals; it does, however, unite with chlorine in several proportions. The best known chlorides are selenium monochloride and selenium tetrachloride. These products are obtained by the action of chlorine gas upon selenium.

Removing Wool from Sheepskin.—Soak sheepskins in lime water until the wool can be removed by scraping with a two-handled blunt knife; or leave the skin in a dark, warm, and moist place until sufficient decomposition has taken place to enable the wool to be easily scraped off.

Mounting Photographic Prints.—This is the plan adopted by professional photographers for mounting prints. Immerse the trimmed prints in water for a few minutes and then place face downwards one on the other on a sheet of glass. Squeeze out the excess of water with a roller squeegee and blot off the surface. Brush over the back of the print with cold starch paste, free from lumps, taking care that the edges of the print are well covered. Raise the print by the corners, lay it in position on the mount, place over it a sheet of fluffless blotting paper, and roll into contact. Continued or heavy rolling is unnecessary. If too much starch is used it will be squeezed out around the edges of the print; if too little is used the print may not stick at all. Should any starch spread on to the mount it is sometimes advisable to remove it by sponging over the whole mount. In mounting, first estimate the position of two opposite corners, then lay the print down so that it touches the mount diagonally. Starch paste more than one day old should not be used, and all lumps, even very small ones, should be carefully removed. Platinotypes require more starching, and do not stick if the undried mounted prints are laid together.

Making Three-legged Folding Fishing Stool.—Below are instructions on making an angler's three-legged folding stool. Commence by marking out the section full size as shown by Fig. 1. Make a three-legged bolt out of $\frac{5}{16}$-in. iron, as shown at A (Fig. 1). Thread the ends, and fit them with circular brass nuts B $\frac{1}{16}$ in. thick, and square washers C and D. Each washer must be drilled in the centre and the four corners. A hole must be drilled to take a No. 4 screw. Three pieces of hickory, ash, or lancewood about 18 in. long, and properly shaped, can be used for the legs. Bore the centre of each leg with a $\frac{5}{16}$-in. bit, and fit the washers on. Put the legs on the centre bolt and screw up, leaving sufficient clearance for the stool to open properly. The ends of the bolts should then be cut off, but enough should be left beyond the nuts for riveting. Open the stool to the required width and cut off the ends top and bottom to the correct bevel, then take to pieces and finish with sandpaper and French polish. Three pieces of strong webbing are sewn together at the corners (as shown at Fig. 2) to form a triangle the size of the stool when open. Put the stool together, rivet over the ends of the bolts, open as at Fig. 3, and tack the webbing on the corners at the top.

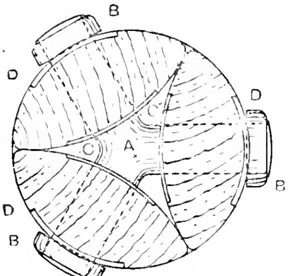


FIG 1

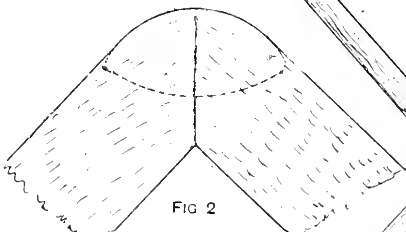


FIG 2

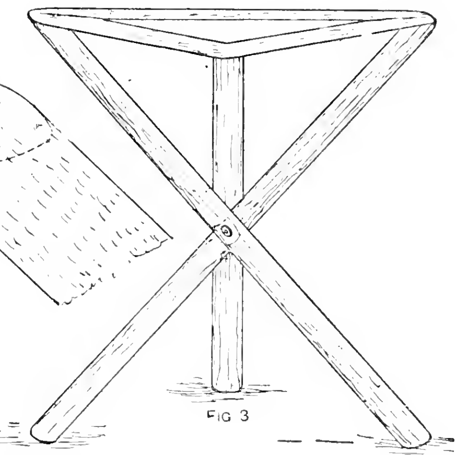


FIG 3

Making Three-legged Folding Fishing Stool.

How to Make Dry Soap.—A good dry soap can be made without the aid of expensive plant. To 40 gal. of water contained in a steam-jacketed pan add from 2 to 2½ cwt. of soap cut up as fine as possible. A white curd soap with free lathering properties is best; on no account must a yellow soap be employed. This mixture is stirred until the soap has entirely dissolved and the mixture is pasty. Now add, in small quantities at a time, 4 cwt. of soda ash, stirring well all the time, then run the soap into shallow galvanised iron trays to cool. When cold, the mass will begin to break up into small pieces. It should be ground to powder in a mill—preferably an edge runner mill or disintegrator.

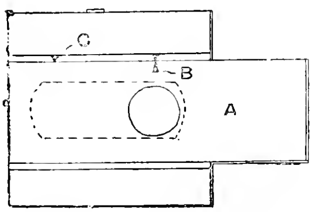
Foundations for Gas Engine.—A solid mass of Portland cement concrete makes a good foundation for a gas engine, and is easily constructed. Solid brickwork is also used, but the excavation required is more than with concrete on account of working room being required for the bricksetters. The best shape for the foundation is as nearly cubical as possible; if made long and narrow, and deeper than it is wide, there is a tendency to rock. To prevent vibration being conveyed to the walls of the building such foundations are sometimes isolated by forming an open trench all round; but if the site of the engine is near a wall it is better to lay a concrete floor under the footings of the wall and make it form part of the same mass as the engine foundation, so that the weight of the building helps to steady the foundation. A stone bedplate should be provided between the concrete and the engine bed. For securing the engine to the foundation, holding-down bolts with anchor plates at the bottom ends may be buried in the concrete, being first placed in their exact positions with the aid of a template marked off the bed of the engine. The upper ends of these bolts are screwed to receive the nuts which hold down the engine. Another method is to cast holes in the concrete through which the bolts may be passed downwards, in which case the heads of the bolts may be at the top and the nuts are tightened up through hand-holes constructed at the bottom ends, but this necessitates leaving a trench for access to the hand-holes. Cotters at the bottom ends of the bolts are easier to adjust than nuts.

Inserting New Wrest plank in Piano.—Wrest-planks of pianos should be built up of three sections—a beech centre, a maple or sycamore facing ¼ in. or ⅜ in. thick, and a pine backing. If the facing alone is split, it is only necessary to replace that portion; but if the plank is so split that a new one must be inserted, proceed as follows. First remove all the wires. If the covered ones can be used again, thread them on a piece of wire in the order in which they were taken off. Remove the wrest-pins, and with a stout piece of brown paper and heelball make a clean imprint of the holes, bridge, etc. Carefully remove the bridge screws or bolts; the old plank may then be chopped out with a mallet and stout chisel. The prepared plank should be cut to exact length and secured in position with good hot glue, and screwed up tightly for several days with iron cramps having deep jaws. When these are removed, clean up the face for the bridge and holes for wrest-pins, their exact positions being determined by means of the brown paper, which is laid in position, and secured while a sharp tap is given with a hammer and centre punch where the holes should be bored. The bridge should be fastened with hot thin glue and brass pins and the necessary bolts, screws, or dowels, and a piece of mahogany or birch capping laid on. But if the instrument is fitted with a half lid it should have a final cleaning up, and several coats of white hard spirit varnish should be applied before the wrest-pins are inserted.

Making Golf Balls.—Golf balls are made from pure guttapercha, procurable in rods and ready for cutting into pieces suitable for the mould, which should be of size 27½. To prevent waste, the cutting is done with a knife operated on the guillotine system; the pieces should be slightly larger than will exactly fill the mould, the superfluous guttapercha being afterwards pared off with a very sharp knife. Before moulding, the guttapercha requires to be thoroughly softened in water kept hot over a fire. The guttapercha is then placed in the engraved mould, and subjected to great pressure. After the balls are made they should be put away in a dry, warm place for about three months to allow them to become thoroughly seasoned. They are then given three coverings of special paint, a small quantity being put on the palm of one hand, and the ball rolled between the palms of both hands. Two days should elapse between each covering, and in a week after the last covering the balls are ready for use.

Preparing Tartaric Acid.—Tartaric acid is largely made from wine lees, *i.e.* the deposit formed when wine is kept in casks. Tamarinds may be extracted with boiling water, the liquid being mixed with a little pipeclay and filtered through animal charcoal to decolourise it. Powdered chalk should be added to the liquid until it ceases to effervesce; the precipitate should be collected on a filter cloth, and a solution of calcium chloride added to the filtrate until it ceases to give a precipitate; the precipitate is tartrate of lime, and should be collected along with the first precipitate. The precipitate should be mixed with a little water and dilute sulphuric acid added in very slight excess. The liquid should then be filtered, evaporated gently to a syrup, and left to crystallise. The crystals may be washed two or three times with cold water, which may be added to the next lot of acid required, and the crystals of tartaric acid should be dissolved in the least possible quantity of hot water, and the solution evaporated and allowed to crystallise again to get rid of the sulphuric acid.

Stereoscopic Photography.—Stereoscopic effect or the appearance of relief depends upon the combining in one in the stereoscope of two representations of the same scene taken from slightly different points of view. Stereoscopic photographs, therefore, are best obtained with a camera having a pair of lenses fitted side by side. These lenses should be accurately matched as regards focus, ratio, aperture, colour, etc., and should be 2¾ in. apart, which is about the distance between the eyes. With this camera two pictures will be taken at the same time. Paired lenses are sold for the purpose. A method of taking stereoscopic photographs with one lens only (a half-plate camera being used) is to employ a couple of mirrors set at such an angle as to have two points of sight. These mirrors are placed in front of the lens and reflect the image through the lens on to the plate. The instrument is known as a stereoscopic transmitter. Still objects, and ordinary landscapes in which there are no moving figures, can be taken with only one lens if the camera is fitted with a sliding front. Such a camera must have square bellows. The above sketch explains the construction of a sliding front. The first exposure is made, and A is then pushed along until the mark B points to the mark C. The opening in the front board of the camera is shown by dotted lines. The distance between the two points may be varied according to the distance of the principal object. The farther the principal object is from the camera the greater must be the separation between the two points. Sometimes it is possible to obtain stereoscopic photographs by moving the object, as, for example, a vase of flowers. In this case the camera and lens are stationary and an ordinary quarter-plate camera can be used. Such a camera may also be used if it is fitted with a board as wide as the base from back to front and about double the length of the original base. Two parallel slots are made in this extra baseboard, and thumbscrews pass through these into the original baseboard. The camera may thus be slid easily from one position to the other and clamped. A great deal depends upon correct mounting of the prints; this is a process that is described on another page, but suffice it to say that the picture that was on the left hand of the camera becomes the right-hand print when mounted.



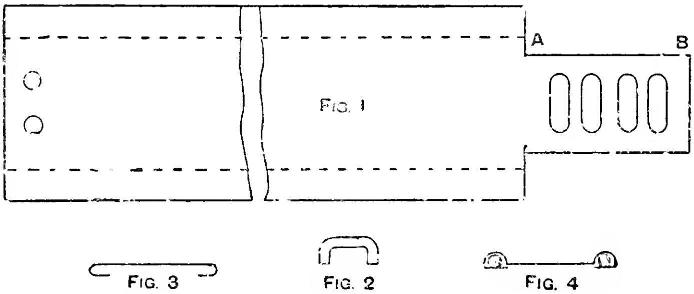
Sliding Front of Camera for Stereoscopic Photography.

Bunsen Burner for Acetylene Gas.—To make a Bunsen burner for acetylene the tube must be extremely narrow, and it is even then found to be very liable to flash back, while it requires a high pressure to bring about satisfactory combustion of the gas with an absolutely non-luminous flame. One of the chief difficulties to be overcome is due to the range over which mixtures of air and acetylene are explosive, and which lies between the limits of 3 per cent. and 82 per cent. of acetylene. The propagation of the explosive wave down the burner tube cannot be satisfactorily stopped by the ordinary device of using wire gauze, on account of the low igniting point of mixtures of acetylene and air; while if high pressures are used so that the rate of flow shall be greater than the propagation downwards, more air is sucked in by the uprush of the gas and the velocity of the explosion is again increased. The best results in acetylene Bunsens have been obtained by taking a Bunsen burner in which a constriction in the air-tube creates a high velocity at the particular point where the explosive wave starts to propagate downwards.

Cleaning White Kid Gloves and Shoes.—For cleaning white kid gloves, make a paste by boiling 1 part of white curd soap with 4 parts of water, and adding a small quantity of ammonia; place the glove on a wooden hand and rub well with the paste, laid on with a sponge, until the glove is thoroughly cleaned. Any worn parts may be improved by rubbing in a little magnesia or white French chalk. Rub the glove dry with a clean cloth, and, after removal from the hand, work the glove about to render it supple again, then press with a heavy weight. Kid boots can be cleaned with the same paste, followed by the French chalk.

Removing Grease Stains from Wall-paper.—To remove grease stains from wall-paper, make a thin paste by mixing powdered starch or flour with benzoline (petroleum spirit). In this mixture dip a sponge, and with it make a ring around the stain. While the ring is still wet, thoroughly soak the stained parts with the mixture. Allow the paste to dry, then remove the powder with a clean soft brush. The object of making the ring around the stain is to prevent the oil being carried away from the spots and forming a ring in the paper, as it does by the usual method of treatment.

Making Brass Dog Collar.—These are instructions on making a brass collar for a dog. Cut a strip of brass 1½ in. wide, and equal in length to the circumference of the dog's neck, with an additional allowance for lap at the end, as shown at A B (Fig. 1). Punch two small holes at the opposite end, into which the ends of the wire staple (Fig. 2) will fit, and also punch out the slots at the end A B. Now fold over the long edges along the dotted line shown, until the section formed is as shown by Fig. 3. Then wire along each side in a crease iron; this would make the section as shown by Fig. 4. Turn the collar round and solder the staple firmly in position and flush on the inside. Any one of the slots on the end opposite the staple end would then hook over the staple, and the collar could be fastened with a small padlock.



Making Brass Dog Collar.

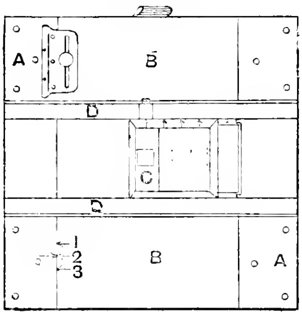
Use of Watch Depth Tool.—A depth tool is used more in making than in repairing watches. It is required for scoring off the exact position of the pivot holes upon the watch plates, previous to drilling them. It consists of two parallel frames, hinged together and capable of being adjusted by a thumbscrew to any required distance apart. Each frame is provided with runners like a small pair of turns. In one frame a wheel is placed, in the other a pinion. The frames are then adjusted to such a distance apart that the wheel runs nicely with the pinion. The outside points of the runners can then be used as a pair of compasses to transfer the exact distance to the watch plate.

Removing Varnish from Boots.—It is difficult to remove the varnish by means of a solvent from patent leather boots; it is better to tree these up tight and rub down with No. 1½ sandpaper, then with No. 1, and finally with flour sandpaper, and when the surface is smooth, to revarnish. The above process will also be suitable if the boots are of calf. But if it is desired afterwards to clean the boots with blacking, first soften the old varnish with a little spirits of wine on a piece of good cloth, and then apply a coat of dubbin.

Browning Bottoms of Boots.—To brown the bottoms of boots, put some thin brown paste on the bottoms and well sleek them just before they are quite dry; repeat till an even colour is obtained, and finish with white heel-ball and cloth. Or whiten the leather, and burnish with a warm burnisher; this will give a darker brown. Finish as above. Another method is to rub a little of the colour on a damp sponge, apply to the boot bottoms, and finish as above. Any brown colour will give the desired effect. To gain an easier finish, instead of using white heel-ball, make some white or brown fake, and, after burnishing, place a little on the boots with the finger, and when nearly dry, rub off with a cloth.

Bleaching Straw.—Brown straw may be bleached by boiling in a solution of washing soda, and, whilst still moist, submitting it to the action of sulphurous acid. To do this, the straw must be hung in a nearly closed chamber; a box or barrel will do if only a small quantity of straw is to be bleached. A piece of roll sulphur is placed on a saucer and set fire to by a hot iron rod; the saucer is then placed in the chamber (below the straw, but not too near it) and left burning for some time. After bleaching, the straw should be washed with warm water to remove excess of sulphurous acid.

Photographing Several Objects at Different Times on One Plate.—It is possible to take twelve different pictures of various subjects on one 5-in. by 4-in. plate, one lens only being used. A repeating back to the camera is needed for such work. But where more than one row of pictures is taken, the back must have a vertical sliding movement as well as a horizontal one. The reversing back is made in two frames: the first or back frame fastens to the camera back frame or into the reversing back catches; the second consists of two rails A A, between which runs a sliding board B with opening C of the desired size, say 1 in. square. Across from A to A run the slide rails D, with a catch in the top and three cuts in the slide to engage with the catch. For the first exposure the slide is put in as shown in the sketch, and is moved forward for each successive one. After three exposures have been made, the sliding board is then lowered to the next point and the slide pulled back to the first position again. By lowering the board and pulling back the slide twice more in this way, twelve exposures, each about 1 in. square, may be made on a 5-in. by 4-in. plate, as has been stated.

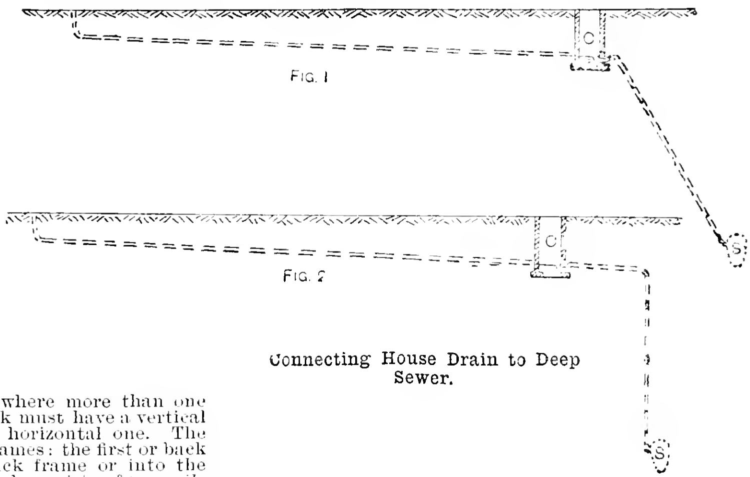


Double Repeating Back for Camera.

Particulars of Welsbach Burner.—Mention is made below of the principal points to be attended to in order to get good results with the Welsbach burner. The burners ordinarily supplied are intended for use with gas of from fifteen to twenty candle-power, and it is an advantage to know whether the gas comes within this range, since it is generally necessary to use slightly larger nipples for a poorer gas and smaller nipples for a richer gas. It is also necessary to know the average pressure during lighting hours, and to select the nipple most suitable for that particular pressure: if, for instance, the pressure varies from 1 in. to $2\frac{1}{2}$ in. during lighting hours, select a nipple most suitable for $1\frac{1}{2}$-in. pressure. Having decided on the most suitable nipple, take care that it is screwed into the socket gas-tight, as the least leakage will cause a bad Bunsen flame; the nipple itself should be examined to see that its interior is quite free from dust, grit, or other foreign substance, and on lighting the gas on the nipple (without the Bunsen tube) the flame ought to be perfectly vertical. See that the wheel on the top of the Bunsen is exactly centred, and lies evenly, perfectly flush with the top of the burner, otherwise the Bunsen flame will be one-sided and cause the mantle to shrink more on one side than the other; the result being that the mantle will be out of shape after burning a few hours. See that all burners are fitted perfectly upright and that the right-sized rod is used with every burner. The rods should be fitted into the burner pretty tightly; if they fit loosely they may be packed with a little asbestos. Also note that the Bunsen flame of the Kern burner is quite different from the ordinary "C" burner. The ring just above the wheel should be of a whitish-blue colour, not green. The mantle ought to be fully incandescent from top to bottom, and no flame should be visible outside or above the mantle. Should the Bunsen flame of the new burner resemble that of the "C" burner it would indicate that the nipple on the burner is too large, or that the flame when lighted on the nipple (without the Bunsen tube) is not vertical. This should be remedied, as it means a loss of forty per cent. of light.

Skeletonising Animals' Skulls.—The usual method of cleaning animals' skulls is to soak the bones in water frequently changed until the flesh becomes decomposed and able to be removed with the fingers and small pieces of wood. This takes some time and is disgusting work. As an experiment, try some wood ashes in the water. Begin by using, say, a handful of wood ashes to a gallon of water, and increase gradually.

Connecting House Drain to Deep Sewer.—In laying a 4-in. diameter house drain, which is 50 ft. long, to join a sewer which is 20 ft. below the level of the house, the pipes should be laid at a reasonable depth, say, 2 ft. 6 in. or 3 ft., with a proper fall to the intercepting chamber. The drain should then either be taken down by a quick fall (as in Fig. 1), or by a vertical drop (as in Fig. 2). In the figures, S indicates the sewer, and C the intercepting chamber. Such a case as this is neither contemplated nor provided for in the Model Bye-laws.



Connecting House Drain to Deep Sewer.

Watch Going too Fast.—A watch will sometimes gain even when the regulator is pushed as far as possible towards "slow." The regulator of every watch is provided with two curb pins, between which the outer coil of the hairspring passes, and in the case mentioned it may be found that the hairspring does not vibrate freely between the curb pins, but binds against one of them. If it already vibrates, opening the curb pins to give more play will cause the watch to go slower.

Varnishing Violin.—Both oil and spirit varnishes are used on violins; the former give quicker results. Oil varnishes should be allowed an interval of at least two days between each coat; each kind of varnish should be dulled with pumice before applying another coat. Coating with boiled oil before varnishing is not advised. A yellow tinge may be imparted by the aid of gamboge and turpentine. A quantity of essential oil of turpentine being put in a cup, it should be placed in a water bath on a gas or oil stove and brought to a gentle heat and as much gamboge added as the oil will take up. Carefully strain, and apply with a camel-hair brush; a second coat may be given in three hours' time. The first coat of good spirit varnish may be applied the next day.

Making Polishing Buffs.—Buffs for polishing metal are made by fastening thick buff leather with best strong glue to the edges of wooden wheels, the ends of the leather being secured by nails until firm. The edges are then covered with glue and rolled in the emery powder (which should be placed in a flat tray), making sure that a good coating is on the leather. This process must be repeated as found necessary.

Curing Sheepskins.—Below is given information on curing and dyeing sheepskins. The skins should first be "fleshed," that is, freed by a sharp knife from any fat or flesh. They are then cured or tawed by placing in some preservative; a suitable one consists of 1 lb. of alum, ¼ lb. of salt, about ¼ peck of bran, and 1 gal. of boiling water. This should be well mixed and covered for some time to allow the bran to swell. The skins are left in the preservative for a day or two, or until the tawing is completed, which may be known by a white line being left when a part of the skin is folded and pinched. The skins are now taken out, stretched on a frame or door, and curried. This is done by scraping in every direction to remove the inner part of the skin. Or they may be curried and stretched after. They are now dried and the scraping continued, being supplemented by shaking and rubbing between the finger knuckles.

Setting Out Dovetailing.—In setting out dovetailing first set out the shoulder lines on each piece; if the ends are shot true this may be done by a gauge. Mark off the centre of each socket, and then half the breadth of the sockets on each side as at A (Fig. 1). Make a template as shown at Fig. 2, the edge A B being square to A C; A D and C E should be about 80° to the edge A C. Then mark out the sockets with a template and a sharp pencil (or awl) as indicated at Fig. 2. Saw carefully in the waste parts; then place the socket piece on the pin piece, and mark the shape of the latter by using the end of a saw placed in the sockets (see Fig. 3). A, Fig. 1, F, Fig. 2, and A, Fig. 3, refer to the same side.

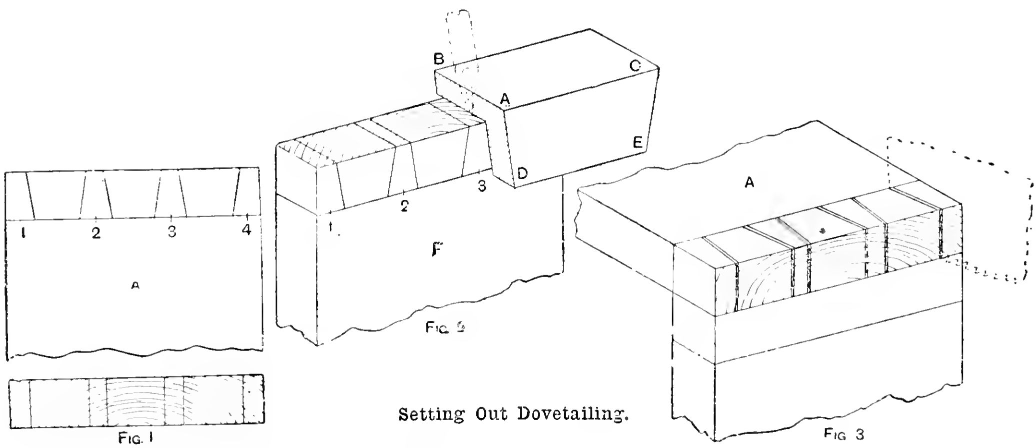


Fig. 1 Fig. 2 Fig. 3

Setting Out Dovetailing.

Cleaning Coral.—Coral that has become very dusty may be cleaned in this manner. In a large pan full of soapsuds hang the coral in a net so that it is submerged, but does not touch either the sides or bottom of the pan, and place the pan on the fire and boil. Then take it off, throw away the water, wash the coral in clean water, replace it in the net, and put it back in the pan as before: fill up with clean water and again bring to the boil. Remove coral, rinse in clean water, and allow to drain.

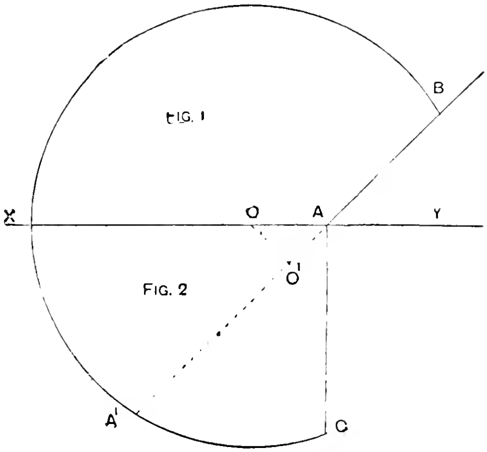
Dressing Tarpaulins.—Railway companies generally use a prepared sheet dressing for yellow tarpaulins. For a yellow dressing, use boiled linseed oil coloured with yellow ochre; if it does not dry quick enough, add a little patent driers. First give the canvas a good dressing with plain boiled oil; when that is dry, coat both sides with the coloured dressing. The dressing should take several days to dry; if it dries quickly it will be liable to crack.

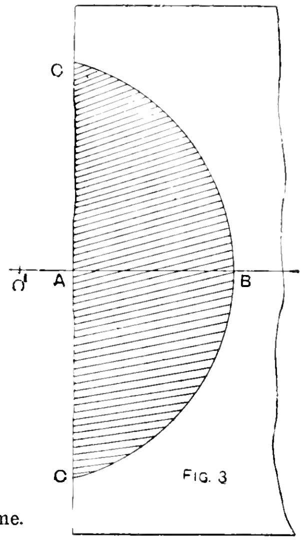
Bronzing Metal Urns and Other Vessels.—Metal tea-urns, spirit measures, etc., are usually bronzed after all seams have been brazed and the metal has been worked to shape. One method of bronzing is as follows. First pickle the article in spirit of salts, then scour it quite clean and free from grease with sand. Procure some crocus of the desired shade, mix to a fine paste with water, and coat the surface to be bronzed thinly and equally. Build up a clear coke fire on the forge, over which move the article about until the paste is quite dry. Place some coal on the fire to render it smoky, and expose the article to the fumes till the surface is quite black. Blow up the fire until it again burns clear and is free from smoke, then move the article about over the fire and as close as possible to the red-hot coke until all the soot is burned off. Allow the article to cool, and brush off all particles of crocus, soot, etc. Tie on the head of the smoothing tool a covering of parchment, or one or two thicknesses of lasting, and with the bright hammer go over the bronze surface until it is smooth. An acid process for finished work is as follows:—Dissolve in vinegar two parts of verdigris and one part of sal-ammoniac. Boil this solution and skim the surface clear. Add water to the solution until no white precipitate remains at the bottom of the vessel. Now thoroughly clean the article to be bronzed, and immerse it in the boiling solution until the desired shade is acquired; then rinse in water and dry with sawdust. If the solution is too strong, the bronze will not adhere very firmly, and a little friction will remove it; if the article is not well dried a green coating occurs on exposure to air. Both the above methods require practice before the desired colour and permanency can be obtained.

Permanence of Photographic Prints.—If the directions given by the makers of the paper are followed, pure chemicals used, and separate toning and fixing baths, there is little danger of P.O.P. prints fading. It is perhaps in the fixing and washing of the prints that errors are likely to be made. The fixing bath, which must not be in an acid condition, should be at the normal temperature and sufficiently strong; if either of these points is neglected fading of prints may result. The bath should be made with warm water, as there is considerable loss of heat in dissolving hypo, and when the temperature is low the bath does its work too slowly. When the prints are put in the hypo the unaltered silver is changed into silver thiosulphate, which is insoluble, and then into a double thiosulphate of silver and sodium, which is soluble. Unless the bath is strong enough to form the double thiosulphate, stains and fading may result. The proper strength for P.O.P. is hypo 3 oz., water 20 oz. For albumen prints use a 10-per-cent. solution of hypo. The prints must be kept moving while they are in the fixing bath. It is important that after fixing is completed every trace of hypo should be removed from the print. For this purpose a mechanical washer may be used; this keeps the prints moving round the washer whilst the hypo sinks to the bottom and is syphoned off. Or the prints may be transferred by hand backwards and forwards between two dishes alternately filled with clean water. After about forty minutes' thorough washing the prints should be free from hypo. A test, however, should be applied. Put a small quantity of starch into a test-tube and add a few drops of a solution of iodine, thus forming blue iodide of starch. Pour half of this blue iodide into another test-tube, and, lifting one of the prints from the washing water, hold it by one corner and allow the last few drops of the drainings from it to fall into one of the test-tubes. If any hypo is present in the drainings it will turn the blue solution white. Compare the colour of the solutions in the tubes by holding them side by side against a sheet of white paper.

Making Bar Soap.—As a preliminary trial in soap making, try the cold process. Cocoanut oil should be used to the extent of from 25 to 50 per cent. if possible, as it not only rapidly saponifies but appears also to hasten the saponification of other oils mixed with it, and forms an easy lathering soap. For trial, dissolve in $1\frac{1}{2}$ pt. of water $\frac{1}{2}$ lb. of caustic soda (that in hermetically sealed tins for preference); place the lye in a jug. Now raise the temperature of the oils to 110° F., pour into a large bowl, and add the lye very slowly, stirring well with a stick. When the lye has been thoroughly mixed with the oils the mixture may be poured into a mould. An efficient temporary mould may be made by lining the inside of an old box with a piece of old cotton cloth, wetted, and folded in several thicknesses. Pour the mixture into the cloth, cover the box over, and place it in a warm place for from twelve to twenty-four hours. If the mixing has been properly performed, a block of hard soap will be produced, which may be cut into bars with a wire.

Roof Cutting into Side of Dome.—It is required to obtain the proper sweep for the plate that runs up the slope of a roof which cuts into the side of a dome. If the dome is a semi-sphere, then the section of the dome formed by the plane of the roof passing through





Roof Cutting into Side of Dome.

it would be a part of a circle. Produce A B, the plane of the roof (Fig. 1), until it joins the plan at A^1; bisect A^1 B to give the centre O^1, and then draw a line at right angles to the ground line from A to cut the plan at C. The distance A C would be half the width of the section's base. To draw the section, set off a line at right angles to, and on both sides of, A B (Fig. 3). Make A C on both sides of A B equal to A C (Fig. 2), also make A B (Fig. 3) equal to A B (Fig. 1). Then mark off from A, A O^1 on the section, equal to A O^1 (Fig. 1). Use O^1 as centre, and with radius to B draw the arc shown, Fig. 3, and this would be the part to be cut from the plate, so that it would fit the dome.

Making Stannate of Soda.—To make stannate of soda, proceed thus. Melt together 2 parts of caustic soda and 1 part of finely powdered tinstone (native oxide of tin). Add to the melted mass a small quantity of hot water, allow to settle, and pour off the clear liquid; this can be evaporated to form the liquid stannate. On further evaporation the liquid will commence to crystallise, and after cooling the crystals may be strained off, washed once or twice with a little water, and dried. The liquid poured off from the crystals should be evaporated to dryness and added to the next melt; the part insoluble in water may also be added so that there may be no waste. Tin crystals (stannous chloride) are formed by boiling tin with hydrochloric acid until no more will dissolve, and then evaporating and cooling the solution; the tin crystals will then separate out.

Testing the Speed of a Camera Shutter.—A method of estimating the speed of a camera shutter is as follows. Attach to the side rim of a bicycle wheel a piece of tinfoil. Invert the bicycle, place it in the sunshine, and focus this wheel sharply. Put a plate in the camera ready for exposure, and set the shutter at its lowest speed, using as large a stop as possible. Revolve the wheel so that it makes one revolution per second, or fifteen revolutions in a quarter of a minute, and when this speed is obtained let go the shutter. Now make a time exposure on the same image, but on another plate with the wheel at rest. The first plate on development will show a blurred arc where the image of the bright tinfoil moved across the plate. The proportion the movement bears to the complete arc is the speed of the shutter expressed in fractions of a second. To find the degree of movement, measure on the negative showing the wheel at rest the width from side to side of the tinfoil, and subtract this from the extension of the arc. Now ascertain with the compass how many times the remainder is contained in the circumference of the wheel image and the answer is the fraction of a second exposure that the shutter gives.

Mixing Oil-colour Paint.—For painting any surface that has to stand the stress of weather the paint should be of as good quality as possible. For a good oil paint take, for each pound of colour required, $\frac{1}{2}$ lb. genuine white-lead, 1 oz. of patent (paste) driers, or a small quantity of terebine, and mix it to the required consistency with a mixture of raw linseed oil 2 parts, turpentine 1 part. If it is required to dry with a good gloss, replace half the raw oil with boiled oil. If a tint is wanted, work in the requisite quantity of pigment ground in oil; ochre for cream, Venetian red for salmon, middle Brunswick green for pale green, ultramarine for grey, burnt sienna for a reddish buff. For dark coloured paints, replace the white-lead with a similar quantity of pigment ground in oil, and use more boiled oil, or else add a little good oak varnish.

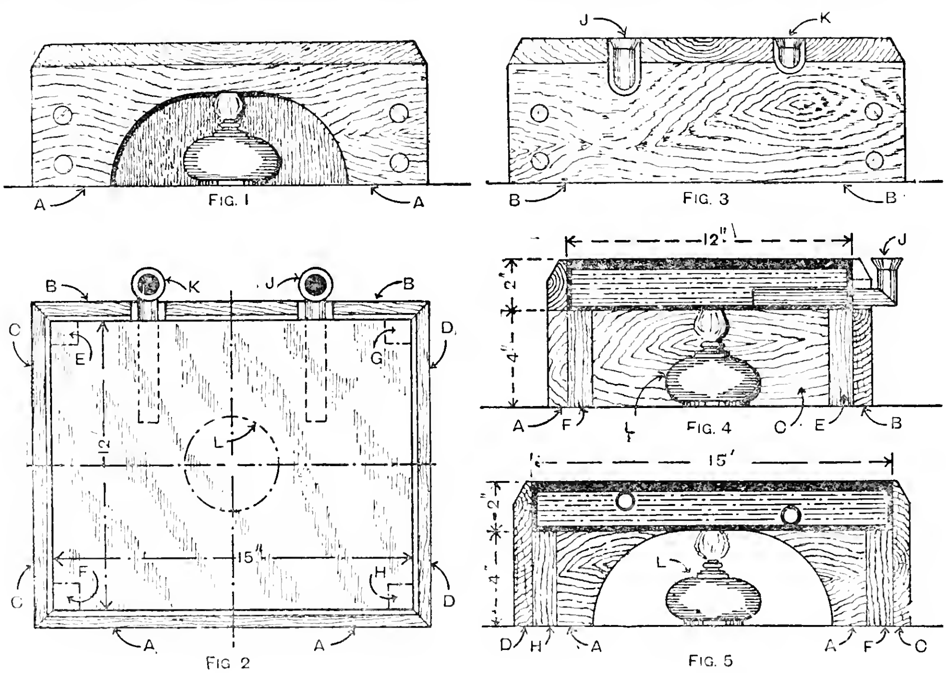
Determining Superficial Surface of Steam Pipes.—The rule most usually adopted for determining the number of square feet of heating surface of different sized steam pipes is to calculate that a foot length of 4-in. pipe has a superficial, *i.e.* square, foot of surface. Then the areas of other sizes can be readily estimated. A 1-in. pipe, for instance, has one-fourth of a square foot of surface per foot run, or a square foot to 4 ft. run. This would also apply to bends, fittings, and other hot parts of the installation. These calculations are based on the interior diameters of pipes. Often the exterior is taken, by which a $1\frac{1}{2}$-in. pipe, 1 ft. long, would be said to have half a square foot of surface, because it is of 2 in. exterior diameter (nearly). This, however, is not a correct way, for it gives a certain size of pipe a variable super surface according to the thickness of the material of which it is made, whereas the thicker material would decrease heating efficacy rather than increase it.

Manufacture of Condensed Milk.—In making condensed milk, milk is mixed with sugar and then evaporated by steam in a vacuum pan, in which a reduced pressure may be kept in order that the milk may lose its water at a much lower temperature than the boiling point under ordinary pressure. The temperature employed is about 100 deg. F., and the vacuum is kept as good as possible. The plant required consists of one or more vacuum pans, a boiler for supplying steam and for pumping, suction pumps, etc., and canning outfit.

Making Sugar Figures.—Sugar figures are made by placing about 2 lb. of sugar in a pan and adding barely sufficient water to cover it and a little cream of tartar; melt down by a gentle heat, and boil to the degree known as "ball," *i.e.* about 250° F. Rub the pan briskly with a stick until the sugar thickens, then fill the moulds as quickly as possible through a funnel. Objects that are flat on one side may be moulded in starch powder, shaped objects in plaster-of-Paris moulds, while large objects are usually made hollow, the moulds being filled with the sugar, and the unsolidified portion being poured out after a few minutes.

Hot Box for Photo Negatives and Lantern Slides.—An aid in varnishing lantern slides made from negatives or in varnishing photographic negatives themselves is illustrated by Figs. 1 to 5, the letter references in these figures being similar. It is usually advised to heat the slide before a fire or lamp before flowing the varnish on and off; in too many cases this means unequal heating and burnt fingers. With this hot box it is only necessary to lay the slides on the top, fill the box with water (boiling or cold), and light the spirit lamp, and in a short time the slides will be heated equally all over. After varnishing, they are left on the top until thoroughly hard and dry. The box consists of eight pieces of wood screwed together, supporting a zinc box with an iron top. The front and back pieces A and B are each 17 in. by 6 in. by ¾ in. The two side pieces C and D are each 14 in. by 6 in. by ¾ in. These four pieces are mitred at the angles, chamfered on the top edge, and screwed to the angle pieces E, F, G, and H, each 4 in. by 1 in. by 1 in., on which rests the zinc box. The front piece has an opening cut in it to admit the lamp L, and the back piece has two pieces cut out to admit the water inlet J and the steam vent K. The hot box is 15 in. by 12 in. (this allowing ¼ in. space between it and the wood) and 2 in. deep. It is made of stout zinc with an iron top $\frac{1}{16}$ in. thick soldered on, forming a level bed for the slides. The water inlet discharges on the floor of the box, and the steam vent is taken from under the top plate as shown. Steam issuing from the water inlet indicates that more water is needed. This box will take one dozen lantern plates and, as has been stated, is equally as well adapted for use in varnishing ordinary photographic negatives.

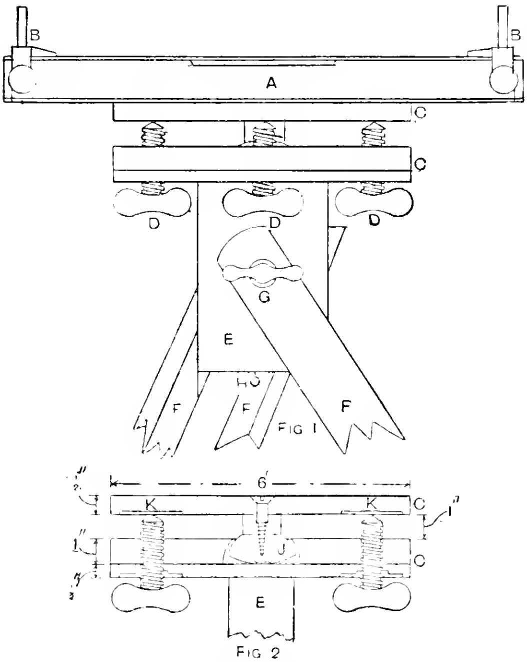
Dry Rot in Floor Boards.—The conditions most favourable to the germination of the spores of the dry rot fungus and to its subsequent growth are (1) a still atmosphere—no draught, (2) a little moisture—not too much, (3) a little warmth, (4) a little ammonia. An air brick on one side of the house is of no use without one on the other side, and both together are useless without holes through the cross walls to allow of a through draught. If the joints of the floorboards are open, a little ventilation may be afforded by currents of air finding their way through. If the upper face of the boards is exposed, the fungus cannot thrive on it; its ravages will be confined to the lower side of the floor, and it will make its way through the boards slowly. Obviously that part of the floor which is covered with loose-textured carpet has the better chance of holding out, but that which is covered with oilcloth, and thus cut off above and beneath from all supplies of fresh air, has everything against it. As regards the moisture, the fungus is greedy for this, although it has to take its supply in very minute quantities from the air or from objects with which it is in contact. So much moisture, indeed, does it succeed in taking in that it has to discharge an excess, which hangs on its surface in clear sparkling drops, hence its name, *Merulius lachrymans* (lachrymans being the Latin for weeping). The remedy is to remove the whole of the floorboards, joists, and other timbers. Every vestige of fungus in any form should be scraped or brushed off the brick or plaster work. Examine the skirting, and remove any that has any suspicion of the growth on it, even the white mould. Clear the ground and take off an inch or two of its surface to ensure getting rid of every trace of the disease and its spores. In some cases an application of fresh limewash to the surface of the walls has prevented further development. Vitriol has also been applied with good effect. If not too expensive, cover the ground with hot lime concrete. Break holes through the cross wall, preferably at the ends, as the air is apt to become stagnant in the corners. Put at least one air brick at the back of the house, and above all things see that the new timber used is not infested with incipient dry rot before it is used.



Hot Box for Photo Negatives and Lantern Slides.

Action of Steam in Locomotive.—A locomotive usually, though not always, has a pair of simple engines. These act as ordinary horizontal steam engines, steam being admitted and cut off according to the notching-up. It then expands to fill the cylinder, pushing the piston before it. Just before the end of the stroke the exhaust port opens and steam is exhausted from one side of the piston up the chimney, its pressure, which now is a back pressure or resistance, falling and the piston being pushed by fresh steam in the opposite direction. The motion of the piston is transmitted through the piston and connecting rods to the crank, and thence to the wheels.

A Simple Level.—With the simple level illustrated the proper grade and levels for drains, ditches, roadways, concrete floors, foundations for houses, and for bridges, etc., can be laid out. In fact, all sorts of levelling can be easily and readily done with this instrument. Fig. 1 shows an elevation of the complete instrument; A is a builder's ordinary level fitted with a pair of Stanley's improved level sights B B. The level is placed on a table C that can be set level by means of four thumbscrews D and sighted in any direction. In the figures, E is a triangular block of hardwood to which are fastened the parallel plates C, and also the three legs by three screws G; H is a small brass eye screwed into the centre of the underside of the triangular block to suspend a plumb-bob if it should be required to place the instrument over a point. Fig. 2 is a section showing dimensions of the parallel plates. The top plate should be of two pieces glued and screwed together, cross-grained to prevent twisting. In the centre is fastened, by means of a brass screw, the ball J for the ball-and-socket joint. In the centre of the top piece of the bottom-plate a hole is made to fit the ball to



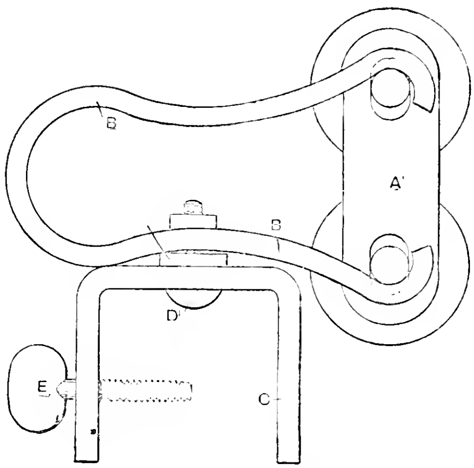
A Simple Level.

form the socket of the joint. Before glueing the two parts of the bottom-plate together, the triangular block of hardwood (3½ in. long with 2-in. sides) must be screwed to the bottom-piece on the under-side. The thumbscrews on the lower plate are equally spaced ¾ in. from the outer edge. On the under-side of the top-plate over the point of the thumbscrews, and for them to bear against, small brass plates K K, Fig. 2, should be fixed. The levelling staff can be made by painting the divisions on a strip of ¾-in. board, or, if preferred, papers printed with the divisions can be obtained and pasted on the board. The instrument is set up and used in the same way as an ordinary dumpy level.

Cod Liver Oil Emulsion.—To prepare an emulsion of cod liver oil, triturate together in a mortar 2 oz. of gum arabic and 3 oz. of water, then add 8 oz. of cod liver oil; slowly beat the whole together until a smooth cream is formed. Now dissolve 128 gr. of hypophosphite of lime and 96 gr. of hypophosphite of soda in 3 oz. of water, and beat this up with the other ingredients. To disguise the flavour of the oil, add 1 oz. of sugar syrup (1 part sugar to 1 part water) or glycerine, and a few drops of essence of almonds; mix these with the other ingredients as before.

Working and Polishing Ebony.—Ebony must be selected for colour, grain and texture first, as these vary very much; the cuts near the bark or outside surface often contain sand and other foreign substances which dull the edges of the tools employed. Ebony may be turned in the lathe, using, for small work, two gouges, one for roughing out and the second for finishing. The tool is held above the centre, a high speed is employed, and light cuts are continually taken, the finishing cut leaving a dead polish which only needs a handful of turnings held against the work while revolving to brighten it. A piece of blanketing with a few drops of linseed oil finishes the work. More elaborate forms of ebony work are cut with a revolving drill in the lathe; and there is also an automatic lathe for turning out handles in quantities. Ebony in the flat is first sawn with a fine circular saw into slabs or veneers. Further shaping may be done with a hand or power fret-saw. The finishing is done by fine rasping and filing, and the polishing is begun by scraping with a sharp knife or a proper scraping tool, always scraping in one direction; the polishing is completed by dollying off on a felt dolly driven by power, the dolly being kept moistened with linseed oil.

Making a Wringing Machine.—A simple wringing machine can be made in this manner. Obtain two indiarubber rollers mounted on spindles; remove the cogs, as these are not used. Also obtain two slotted plates as A (see sketch), made from 1¼-in. by 3/16-in. iron; the slots in the plates must be of a size to fit easily on the spindles of the rollers, the distance apart being regulated by the diameter of the rubber. Also make two



Making a Wringing Machine.

springs from 1-in. by 3/16-in. steel, shaped something like B. Two clips, as C, will also be wanted; the top part must be drilled to take a bolt D, a corresponding hole being made in the two springs. One leg of each of the clips must also be drilled and tapped, and a thumbscrew fitted, as E. To fit the parts together, first place the two roller spindles in the slots in plates, then spring on the impression springs, one on each end. Now measure the distance from centre to centre of the two springs, and drill a piece of flat iron so that it will fit between the springs and the clips, as shown at F; this will keep the springs rigid sideways. The clips with thumbscrews are for fixing the machine to the washtub, and, being fixed by one bolt only, will swivel round so as to be used at either angle. One of the roller spindles should be squared or threaded for a winch handle. All the iron-work must be well painted or given two good coats of bath enamel.

Bending and Canvassing Landau Panels.—If nailed flat across the boot-side, with the top edge rounded down, or overhung to form a bead in the neck, the panel should be bent and canvassed before fixing. This must be done very carefully, or the panel will split. To canvass a panel after it is bent, place it on a wide board, round side up, and drive in a draw-bore pin at each outside corner; this will prevent the panel sagging in the centre, which would split it. If the panels are boxed in flush, canvass them after they are pinned in. Quarters and back panels should be canvassed a day or two before they are wanted; there is then less danger of breaking them when fitting them in the grooves. This only applies to panels with a slight single sweep; where there is a return or chair-back sweep they must be canvassed after they are in.

Noise in Hot-water Tank.—It is sometimes the case that a hot-water apparatus works well until the water reaches the boiling point, when a rumbling sound at the tank is heard. This noise is merely the sound of the water boiling. The remedy is to regulate the boiler damper so that the water shall not boil. When the noise occurs, it can be silenced by drawing off some water at one of the hot-water taps. This causes cold water to flow into the tank and reduce the temperature. The fact that water has a tendency to boil indicates either the use of a more powerful boiler than the apparatus requires, or want of attention to the damper. The latter is the more probable fault, causing the boiler to become overheated and fuel to be wasted.

Making a Round Net.—In netting a round net, the loop upon which the first meshes are made can be afterwards tied up tightly to form a bottom. Or the first meshes can be cut away, the short cut ends pulled out through the inner bights of the second row (that is, the now inner row of whole meshes), and a grommet worked if a circular hole is wanted; or the ends can be drawn together and tied with a separate piece of string. To prevent crowding of meshes at the bottom of a round bag it is usual to commence with about six meshes for the first row, making the first as small as possible at the tapered end of the mesh, the last two being worked loosely at the broad end; the first stitch of the second row will then be nearly regular in size, and in the third row all will be even. But in this row, if the net was commenced on six meshes only, stitches must be added; to do this, work two meshes on each loop of the former row, or two on every other loop, according to the shape of net required. In this way add meshes in any row where it is desired to increase the diameter. It is not often wished to decrease the diameter of a round net, but if required to do so, pick up two meshes on the needle at once and hitch together in one; each time this is done one mesh less will, of course, follow in the succeeding row.

Manufacture of Calcium Carbide.—Calcium carbide may be made by heating an intimate mixture of finely divided coke or carbon and lime in an electric furnace, using a current of from 4,000 to 5,000 ampères. The furnace used by Willson in America consists of an outer coating of firebrick lined with carbon or graphite, a tap hole being placed near the bottom; the furnace is covered with carbon plates, through which passes a thick carbon rod reaching nearly to, but not touching, the bottom of the furnace; the carbon rod and the inner carbon layer are connected to the dynamo. 1,200 lb. of fine coaldust and 2,000 lb. of quicklime yield 2,000 lb. of carbide in twelve hours.

Centrifugal Pump.—Herewith are dimensioned drawings of a centrifugal pump designed to lift 150 gal. per minute at 20 ft. head. To enable the volute to be correctly formed the case is in two halves. To avoid end thrust and to ensure an even balance of the disc, the inflow takes place on each side, each inlet having a diameter of 3 in. Fig. 1 is a side elevation and Fig. 2 one half of the case showing the depth of the volute and disc with angle of vanes. The volute, to obtain a good flow, must increase evenly to its discharge. The discharge pipe should increase in area to reduce the velocity considerably. The flange of the casing is 1 in. wide, drilled to take ⅜-in. bolts. The diameter of the disc is 9 in., and is arranged for six vanes, having an angle of 80° at the circumference. The shaft is ⅞ in. diameter, and the approximate speed of disc is 650 revolutions per minute. Fig. 3 is a section showing side inlets, disc, and brackets, and Fig. 4 is a section of half of the disc showing dimensions of the vanes.

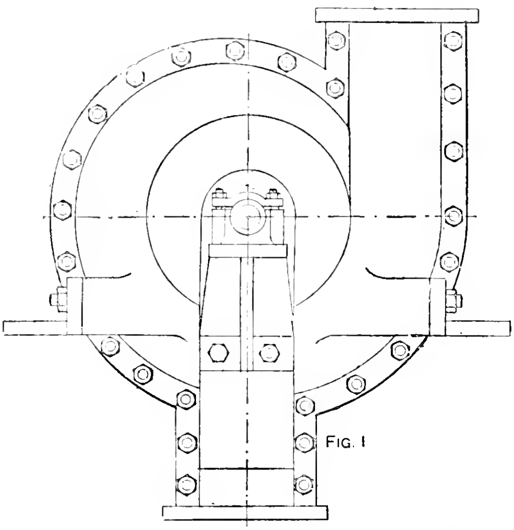


FIG. 1

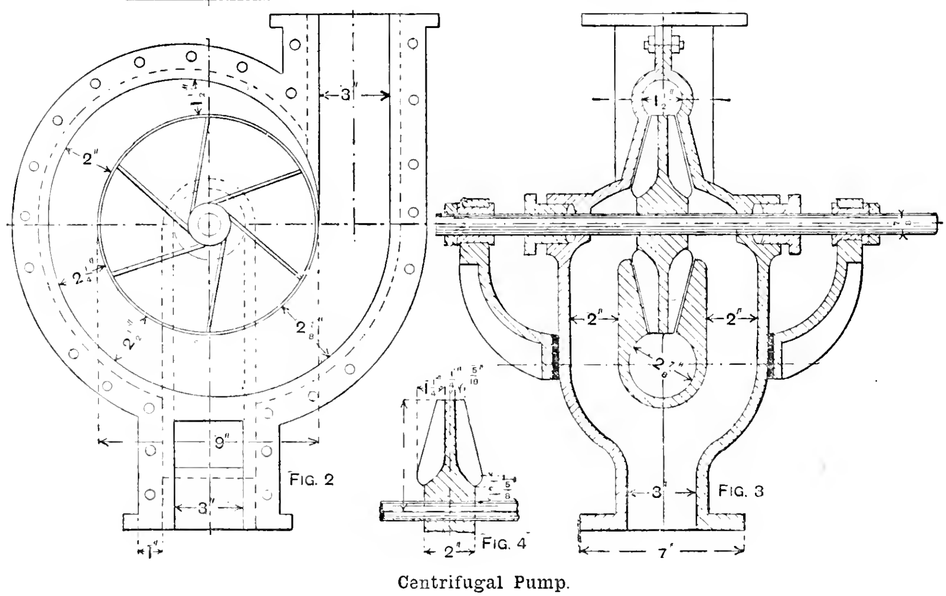


FIG. 2
FIG. 4
FIG. 3

Centrifugal Pump.

Glazing Clay Tobacco Pipes.—A simple lead glaze is generally used for clay tobacco pipes. The following may be taken as examples. (*a*) Lead oxide (litharge), 45 parts; sand, 35 parts; common salt, 6 parts. (*b*) White lead, 53 parts; Cornish stone or felspar, 16 parts; white flint glass, 5 parts. The glaze may be melted in a crucible, and the stems of the pipes (which should have been previously burnt) dipped in. For green colour, use 5 per cent. of oxide of copper; for red, 5 per cent. of red oxide of iron.

Polishing Turned Wood.—Soft woods may be turned so smooth in the lathe as to require no other polishing than that produced by a few fine turnings or shavings of the same wood applied while revolving in the lathe. Mahogany, walnut, and some other woods may be polished by the use of a composition made by dissolving by heat so much beeswax in spirit of turpentine that the mixture, when cold, shall be of about the thickness of honey. Or instead, dissolve 1 oz. of sandarach in ½ pint of methylated spirit, and mix the solution gradually with 1 oz. of beeswax in sufficient turps to make it into a paste. Apply with a woollen cloth whilst the work is still in motion, and polish with a soft linen rag or chamois leather. The work thus treated should have a highly varnished appearance. Hard woods may be readily turned very smooth, and fine glasspaper will suffice to give them a very good surface; a little linseed oil may then be rubbed on, and a portion of the turnings of the wood to be polished may then be held against the article while it revolves rapidly. By this means a fine gloss will be imparted.

Scenting Powder.—To perfume a powder with otto of roses, place it in a mixing machine, *i.e.* a revolving cylinder or barrel provided with ribs internally. Spray the scent into the powder and set the machine in motion until the scent has been disseminated through the whole. To disseminate the scent better, dissolve 1 part of the otto in 6 parts of spirit of wine, and use the mixed essence in place of the pure oil.

Making Silver Mounts for Tobacco Pipes.—In making an ordinary pipe mount, a plate of silver has to be prepared to fit tightly round the two pieces of the pipe to be joined by its means. The easiest way to obtain a pattern of this plate is by wrapping a piece of smooth paper round the place on which the mount is to go, and very carefully cutting all the surplus away with a pair of scissors until one thickness of the paper is all round the pipe. If this is done carefully and due attention is paid to the straightness of the soldering seam and of the ends, the silver can be cut to fit exactly. The plate must be flattened, and then turned up into a tube quite free from bruises or kinks. For this is required a "triblet," which is a tapering piece of smooth round iron or steel; a bending block is also required. A mallet also may be necessary if the silver is thick; thin metal will come up by the pressure of the hand almost, and may be worked with a pair of half-round pliers in place of the block and mallet. With a knife or a scraper made from a three-square file, make the edges to be soldered together quite level and true with each other; see that no burr from the file is left on the metal when tying with wire. Should the mount be long, it is desirable to file small nicks in the edges that form the seam *a a* (Fig. 1), so that the solder may hold better; the seam will not be so likely then to open during the subsequent operations. When fitted, the tube is tied with iron binding wire so that the edges remain in the proper position whilst soldering. Thin wire should be used, as thick wire on cooling and shrinking may bruise the work. The tying of the wire is not a difficult job, but with a very tapering mount means have to be taken to prevent the binding wire slipping down (see Fig. 1). In soldering, which is the next process, brush the flux on the edges to be united, which previously should have been scraped clean. The flux is borax rubbed up in water. Lay some pallions (small pieces) of silver solder along the seam, and with a gentle heat from the blowpipe flame evaporate all moisture. Then, if the solder has not been shifted, apply the full heat. When cold, pickle in a mixture of 1 part of sulphuric acid and 10 parts of water, and file off any pieces of unflushed solder. The mount now is sure to be more or less out of shape, so it has to be trued on the triblet previously mentioned with a smooth-faced mallet. The work could be more easily done in a lathe, which would also be useful in the subsequent polishing. If the metal is so thin that the triblet and mallet or hammer are of little service, use a ribbed burnisher (Fig. 2), with which it is quite possible to rub the thinnest of collars true and smooth. The burnisher may be from 7 in. to 10 in. long, 1 in. wide, and $\frac{1}{16}$ in. thick, and can be made from an old flat file. The ribs or ridges should be quite smooth, and should be of the size shown in Fig. 2. When the mount is in shape, and fits the pipe, it will have to be smoothed and polished. Remove hammer marks, etc., by filing, and not by the use of glasspaper or emery-cloth; by the latter means the corners are rounded instead of being left sharp. The next thing is to polish the mount. The principle underlying most polishing processes is a simple one. It is the application by friction of abrasive materials in stages of gradually increasing fineness. If that is understood, it will be an easy matter to make shift with materials that may be handy, though those mentioned here may be obtained in small quantities at oilshops and of dealers in jewellers' materials. As the mount to be polished may be thin, and therefore likely to get out of shape, a piece of wood should be fitted to it, and this will both support it and allow it to be handled with comfort. First is used a stick of water-of-Ayr stone with water, a damp sponge being employed to remove the mud-like stonings as they are produced. This is followed by pumice powder and oil, and this by crocus and oil (or rotten-stone or Tripoli powder and oil). These may be applied by means of buffs made by glueing strips of buff leather to pieces of wood. Next softly brush the mount with damp whiting, and then wash it in hot soda and water to remove all the contained grease in the polishing materials. The final polish is given with rouge, applied by a buff at first, and then by the palm of the hand or the ball of the thumb. Wash off all rouge, and the mount is then ready for fixing on. It is important in using the rouge that the hands, rouge, and everything by which the mount is touched be quite free from grit. Jewellers' rouge is not that sold as face powder, but is peroxide of iron specially prepared. The best quality has a red colour having a decided purple tinge. Rouge varies in colour from the one mentioned to a deep red.

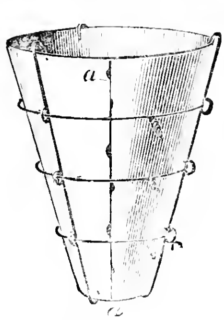


FIG. 1

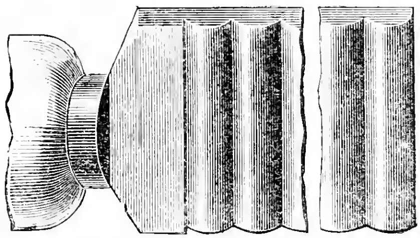


FIG. 2

Making Silver Mounts for Tobacco Pipes.

Ball Clay for White Enamel Body.—Ball clay used in the preparation of white enamel body may have a composition of Cornish stone, 40 parts; Cornish clay, 10; and blue clay, 20. Or Cornish stone, 80 parts; Cornish clay, 20; blue clay, 40; and flint, 20. Or Cornish stone, 100 parts; Cornish clay, 20; blue clay, 18; and flint, 40. Or Cornish stone, 30 parts; Cornish clay, 10; blue clay, 17; and flint, 8. The colour can be rendered bluish-white by the addition of a little cobalt blue. The non-fusible materials added to the glaze are barytes, bone ash, and oxide of tin; the latter is put into nearly all enamel glazes. The clays are mixed with excess of water, passed through a fine sieve, and then boiled down to a paste. Here are recipes for white glazes. White glass, 100 parts; white sand, 50; salt, 40; litharge, 120; and oxide of tin, 60. Or lead and tin ashes, 44 parts; sand, 41; soda, 2; common salt, 8; and red-lead, 8.

Pressure of Water.—A pressure is often stated as being equal to so many inches of water. If the height of water were 1½ in., the expression would mean a pressure equal to that caused by a column of water 1½ in. high, or, in other words, the weight of such a column. On the square foot this will mean a pressure of 7·7941b.; on the square inch, $\frac{1}{144}$ of this, or ·0541b. The higher pressures are usually measured by a Bourdon or other pressure-gauge; the light pressures are ascertained by inserting a tube and measuring how many inches of water in the tube are required to balance the pressure—thus the term, a pressure equal to so many inches of water.

Cement for Jointing Hot-water Pipes.—Cement for making joints in hot-water pipes contains 80 to 100 parts, by weight, of iron borings (which must be pounded if coarse), 2 parts of flour sulphur, and 1 part of powdered sal-ammoniac. The ingredients must be well mixed and moistened with water, this being done from half an hour to two hours before use, according to the weather. The joint is first caulked a little more than half full of yarn, then finished with the prepared borings. The borings must be caulked in carefully, or the socket will be split as the joint sets, for the borings expand a little in setting.

Paint Blistering on Front Door.—The blistering of paint is caused by the presence of water either in the paint or in the substance to which the paint is applied, greatly aggravated by the action of the sun upon the door. The old paint should be burned off with a spirit lamp, and the surface of the door well rubbed down with glasspaper. Then give a priming coat made of 2 lb. of white lead, 3 oz. of red lead, and 3 oz. of yellow ochre (note that the red lead is a drier). Thin with one-third raw oil and two-thirds turpentine. Finish in any desired colour, using as little oil as possible, or turpentine instead of oil. Varnish on a dry day with a good varnish. It is better not to buy the varnish from an oilshop. Clean all water out of the brush before painting; a dirty brush—*i.e.* one with water in it—is often the cause of paint blistering.

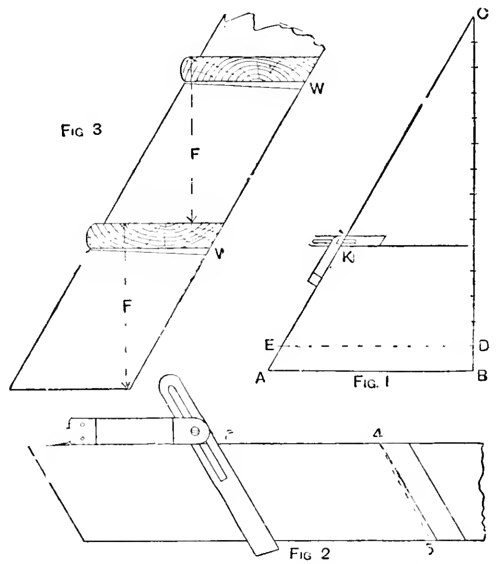
Gilding and Silvering Leather. — Gum mastic in fine powder is first dusted over the surface to be gilded. An iron or brass tool bearing the design upon its face is then heated to the proper temperature and gently pressed on a piece of leaf gold, which adheres to the tool. On pressing the tool lightly to the surface to be gilded the mastic softens and retains the gold. The loose gold and powdered mastic are then brushed off. Gold leaf will adhere to leather without mastic, but not so firmly as with it. To apply tinfoil or silver leaf, place on the part of the leather to be covered some size or white of an egg, and after pressing down the metal and drying, wash over with gold-colour lacquer. The following tools, etc., will be required. A long, thin knife, straight, and not too sharp; a wide thin brush, with camel hair about 3 in. broad; a pad for cutting the gold leaf, and a dabber, a small soft ball of cotton-wool enclosed in a square of muslin with its edges drawn together and tied to form a handle, and wheels and stamps of the shapes required.

Cleaning Bronze Chandelier. — To clean a bronze chandelier that is corroded by damp, take the chandelier to pieces and carefully remove all pins, screws, and other iron parts. Then place about ½ lb. of potash in 1 gal. of water, and in this boil off all the old lacquer. Allow the various parts to remain in the solution for about twenty-five minutes; then take them out and well wash in clean cold water. They should then be dipped in aquafortis, and allowed to remain sufficiently long to become bright. Each part should be held in the acid bath by means of a copper wire twisted round, or by holding with a small pair of brass tongs. Then well rinse in several changes of clean cold water, either by having several vessels or by well rinsing in running water. Transfer to the sawdust tub, dry, and relacquer.

Making Warner Wheels.—Procure a pair of Warner stocks and set of spokes to match; these are supplied with the iron band mortised the exact size of the bottom part of the spoke just above the shoulder, which is sunk or housed in full ½ in. from the face of the iron band, the shoulder of the spoke resting on the wood centre of the stock. To fit the spokes into this part, the mortises already made must be eased out to ensure a good fit to the tenon of the spoke. Before driving the spokes into the stock, clean off the front end of the stock quite level, and fix with a coach-screw, dead in the centre, a strip of wood called a set-stick; this must be perfectly straight and parallel, 2 in. wide by 1 in. thick, and a little longer than the spoke. Measure the distance from the front of a mortise to the set-stick. In the set-stick, at the height of the shoulder of the spoke, bore a hole, and insert a piece of cane or whalebone, keeping it as much shorter than the distance from the mortise at the bottom as the dish required in the wheel. In wheels of this description ¼ in. is sufficient when made, as they go more in tyreing. Drive all the spokes in, so that they touch the peg in the set-stick. To get the tongues all alike, plane a small piece of panel board to such a width that when held against the inside of the set-stick the opposite edge of the board comes on the spoke full ¼ in. Mark all round by this. Now set off the size of the tongue with compasses, and cut down, sawing the shoulders on the front and back only, pulling out the sides with the draw-knife. In large firms, the tongues are made with hollow augers, which cut a square shoulder right round the spoke; but this method is not so strong as that described above. In cutting in the felloes or rims, see that the joints are square and true, and bore the dowel holes parallel with the face of the felloe; also bore all the holes for the tongues exact, as when they are bored through at different angles it is impossible to get a true face on a wheel; undue strain is also put on the tongues of the spokes, so that they soon break off short at the shoulder.

Darkening Cement for Pointing.—For darkening cement to be used for pointing brickwork bricklayers use smithy ashes, which can be procured from any blacksmith. The ashes should be ground or crushed to the size of sand (not crushed to powder) and used instead of sand, or sometimes a small quantity of sand is mixed with the cement and cinders. The wearing qualities of the cement are not improved by the use of cinders. Lampblack is occasionally used as a colouring agent, and when it is used sparingly the wearing qualities of the cement are not lessened.

Setting Out the Sides for a Step Ladder.—In setting out the sides for a step ladder, first set up the vertical height C B (Fig. 1) to a convenient scale, and divide for the number of steps required (the usual distances, as shown at F, Fig. 3, being from 7 in. to 9 in.).



Setting Out the Sides of a Step Ladder.

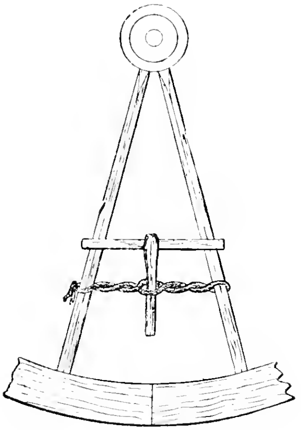
Next set off the splay A B (Fig. 1). Join A to C; this will be the pitch of the sides. Draw a horizontal line and set a bevel to this and the pitch line as shown at K (Fig. 1). Now draw a horizontal line D E, then A E will be the distance apart of the treads measured along the edge of the strings (sides). Set a pair of compasses to this distance, and step them along as near as possible to the outer edge of the string and mark off with bevel as shown at Fig. 2. Fig. 3 shows the usual section of steps which are often wedged into the housing of the string as indicated at W. This would have to be allowed for as shown at 4, 5 (Fig. 2).

Bricks for Cupola of Furnace.—For lining cupolas for blast furnace or other cupreous slags, nothing is better than Dinas bricks unless it be ganister bricks as made at Lowood near Sheffield. The only difference between the two is the quantity of silica contained in each. A good Lowood brick has assayed out at the following proportions: Silica, 96·4; alumina, 1; lime, 1·25; sundry oxides, 1·35; while a best Dinas brick from Wales assayed out as follows: Silica, 95·75; alumina, ·4; lime, 3; sundry oxides, ·85. Ganister bricks do not, on cooling, crack so quickly as Dinas bricks, because Dinas bricks, having a higher percentage of silica, are practically infusible and unaffected by the great heat. The bricks, either Dinas or ganister, should be set in the very thinnest of ganister cement, the usual plan being to dip the brick in very thin cement, and when the work is finished to slurry over the surface with thin cement.

Determining Discharge of Water through Pipe.—The water velocity in feet per second corresponding to a given pressure can be calculated by multiplying the square root of the pressure in pounds per square inch by 12·19. The velocity being thus obtained from the effective pressure, multiply it by the area of the pipe in square feet and by 6·23 to determine the quantity discharged in gallons per second.

Lines on Picture Mounts.—There are several methods of placing gold lines on mounts for pictures. First make small pencil dots where the lines are to end. If gold powder is used, make the lines with a strong solution of gum, and when this is "set" breathe gently on the lines, and dust on the powder. White lines are made by means of white ink, a heavy mixture of Chinese white. A common pen kept well charged will answer admirably as a means of applying the ink.

Putting Felloes on Wheels.—Herewith is an illustration of a device for pulling towards each other the spokes of cart and carriage wheels. This dispenses with the lever and other tools used in some methods of doing this work. Having fitted the spokes and holed the felloes to suit, tie the ends of about a yard of tough cord about $\frac{3}{8}$ in. in diameter to form a ring, which is slipped over two spokes, and then twist this with the handle of a hammer until the spokes come to position. Then by a piece of lath, as shown in the figure, keep them up as long as required; by removing the hammer and undoing the running knot the appliance is ready for another pair.

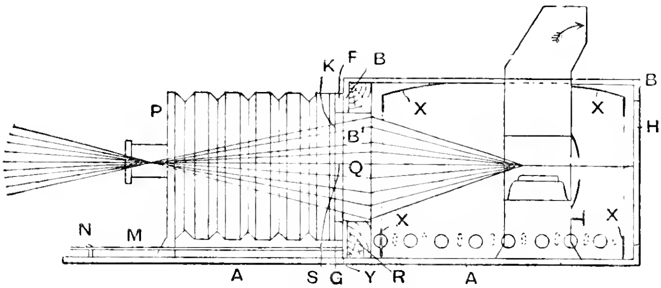


Putting Felloes on Wheels.

Removing Paint from Floor Boards. — Freshly slaked limewash, to each bucketful of which is added at least 2 lb. of common washing soda, makes a good paint remover. It should be applied by means of common fibre brushes—not bristles; several applications may be necessary to remove the paint. The latter should be removed by scraping when soft, then swilled off with plenty of clean water, and finally brushed over with common malt vinegar. It is doubtful whether, after this treatment, the boards will be sufficiently clean to be left as white without bleaching. For the latter, frequent applications of oxalic acid—2 oz. to 1 pt. of water—will generally suffice. Partially to remove the black so as to gain an old oak effect, try equal parts of turpentine and methylated spirit. If this can be made hot with safety it has greater penetrating power. Liquid ammonia is also effective, but is best handled if diluted with an equal bulk of water.

Willis's Odontograph.—The Odontograph, invented in 1838 by Professor Willis, has been used to determine the radii of arcs of circles that shall approximate to the epicycloidal and hypocycloidal curves which should be used if perfect forms are wanted for the teeth of wheels. The instrument consists of a scale and a table. The first may be set out as follows on a piece of cardboard about 14 in. high by $7\frac{1}{2}$ in. broad. At the right-hand edge, and about $2\frac{1}{2}$ in. from the base, take a point. From this point divide the edge into lengths of $\frac{1}{2}$ in. and number the divisions 10, 20, 30, etc., both above and below the point first marked, which should be numbered 0. Then subdivide each $\frac{1}{2}$-in. division into ten equal parts, and from the point first marked (0) set off a line towards the base at an angle of 75° with the vertical. The tables on the instrument show the place of the centres of the arcs of flanks and faces upon the scales for wheels with teeth numbering 12 to 150, and for racks, the pitches varying from 1 in. to 3 in. Other pitches may be found proportionately; thus, for a $\frac{3}{4}$-in. pitch, take out half the table value for a pitch of $1\frac{1}{2}$ in. To use the instrument, one half the pitch is marked along the pitch circle of the wheel to be set out at each side of a radial line. From the two points thus found radial lines are set off. Then the sloping line of the instrument is placed so as to coincide with one radial line, with the edge of the scale over the point on the pitch circle. Then consult the table of centres for flanks of teeth; the number in the table, which varies with the pitch and the number of teeth, shows the point on the scale line above 0 at which the centre of the curve for the flank of the tooth is situated. Similarly for the centre of the face of the tooth set the sloping line on the other radial line with 0 on the pitch circle. Then the table shows the position of the centre on the scale measured downward from 0.

How to Make an Enlarging Lantern.—Below are particulars on the construction of an enlarging lantern. Make a baseboard A, and to this attach the frame B of three sides, with a circular opening in front for a condenser at B¹. Above and below this opening fasten grooved rails F and G to take the sliding negative frame. Join up four mitred pieces to form a frame K, and make the lens-board P. Connect the two with bellows. Bore a hole through K and P to take a brass rod M. Fasten K to F and G, and fix a turn-pin of stout wire at N to clamp the rod M. Fit up the negative frame



An Enlarging Lantern.

to go in S, with an opening 4 in. by 3 in. and $4\frac{1}{4}$ in. by $3\frac{1}{4}$ in. rebate. Sink the rebate deep enough to allow of the turn-buttons which hold the negative coming flush with the surface. The condenser Q is fitted in a block R. Inside B is a second frame X of Russian iron. The holes in this (see dotted lines) are not opposite those in B, so that ventilation without outside light is secured. Short rails are fitted on A, between which the lamp with reflector runs. A four-wick paraffin lamp will be best. Fit a door H. The base is hinged at Y. This lantern could also be used as a magic lantern.

Repairing Broken Rib of Ivory Fan.—The mending of the end rib of an ivory fan containing a fracture about an inch long, is a rather difficult job, as the joining up must be done from the back. Procure a thin veneer of ivory 2 in. long and rather wider than the rib of the fan. Scrape the surface of the veneer and the back of the fracture and fasten together with cement. When set, dress off the sharp edges with a file, and reform the edges of the carved surface by filing and scraping, taking particular notice that the strengthening piece does not cause the fan to bulge when shut up. If the rib is saw-pierced as well as carved, the holes may now be drilled to admit the saw, which must be carefully worked round the original piercing. A more substantial job, if the fan is valuable, would be to procure a veneer of African ivory about $\frac{1}{8}$ in. thick, the carving and dressing of which would bring it down to $\frac{1}{16}$ in., the relative thickness of the end ribs. For convenience of handling, this veneer may be tacked down by the four corners on a flat piece of wood. The design may now be drawn on the veneer with pencil and the pattern cut with sharp gravers such as engravers use. To get the stuff out clean and smooth, each cut must be repeated till the proper depth is obtained. If the work is merely an incised pattern, filled in with either black or red pigment, the engraving is done with a well-whetted lozenge graver, the work being dressed off when the engraving is done and the filling set by brushing with wet whiting and then with a softer brush and dry whiting to give the finishing polish.

The Preparation of Kaolin.—Kaolin or China clay is the basis of porcelain and many pottery clays, and is produced by the decomposition of felspar. Kaolin occurring in the position of the original felspar is called residual kaolin, and frequently it happens that this is carried away by the streams and deposited as sediment in a distant locality, when it is known as transported or sedimentary kaolin. The residual kaolin is likely to contain fragments of crystalline quartz, mica, and undecomposed spar, with smaller quantities of other minerals; while the transported kaolin is likely to contain iron oxide, lime carbonate, and other impurities intimately diffused with it. The residual kaolin furnishes the purer grade, as its impurities may be washed out; whilst the impurities in the sedimentary kaolin are not of such a nature as to be washed out. The common method of mining kaolin in the United States is by means of vertical shafts 25 ft. or 30 ft. in diameter, lined with pieces of wood, each 3 in. by 10 in. or 12 in. by 24 in. The ends are bevelled, so that when the pieces are laid end to end around the sides of the vertical shaft they form a strong wall capable of resisting the great pressure from the clay. As the shaft is sunk, the walls are added to by building from below. Sometimes the clay is mined from open pits, and in a few instances it has been obtained from underground galleries by using heavy timbers, but in most cases the shafts lined with wood are found to be the safest and most economical method. The different methods of washing the kaolin to remove the coarse impurities are all based on the same principle, that of flotation. The material is thrown into water, and the particles of the clay, being finer and lighter than those of the impurities, remain longer in suspension; hence it is only necessary to increase the length of the troughs through which it is carried or to decrease the rate of flow, or both may be done, to get the required degree of fineness in the kaolin, and remove practically all the foreign ingredients. One method

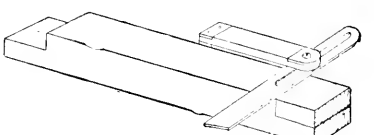


FIG. 1

Setting Out Frame for Wheelbarrow.

commonly employed is to feed the crude material with a current of water into an ordinary log washer; this consists of a horizontal beam from 10 ft. to 25 ft. or more in length, revolving in a horizontal, rectangular, or semi-cylindrical trough of about twice the diameter of the beam. Mounted on the beam are numerous short arms or knives which cut and stir up the lumps, and at the same time carry it slowly to the other end of the trough. The current of water carrying the clay passes from the log washer into a trough or a zigzag series of troughs. The length traversed by the current in the washing troughs and the rate of flow may be varied to suit the character of the material used and the grade of kaolin required. The greater portions of the coarse sand and the larger particles are dropped either in a log washer or close to it, and sand wheels are used to remove this and prevent the troughs from being clogged. The finer sand and the mica flakes are deposited in the zigzag troughs, which are usually about 700 ft. long; they are opened and the deposit is scraped out at intervals. The kaolin carried in suspension by the water flowing through this long zigzag channel is run into larger vats or settling tanks. From these, after a time, the clear water is drawn off and the mud is pumped into a filter press and squeezed by hydraulic pressure. The presses consist of a series of flat iron or wood frames, strung on a central iron pipe. Bags of heavy cloth are placed in the spaces between the frames and connected with the central pipe, which is connected with the pump. The kaolin comes from the filter press in large cakes either round or square, and so that they may dry, these are exposed in racks to the air for several weeks, or put on a floor or in a tunnel and heated by steam or hot air. The cheaper grades of clays are not put through a filter press, being either dried in the settling tanks or transferred to a drying floor directly from the tanks. Another method of washing is to put the clay with water into vessels, where it is thoroughly disintegrated by means of plungers. It is stirred up into a slip which is run off through troughs to settling tanks, made preferably of cypress wood. The kaolin slip is carried thence into the other tanks, whence it is pumped into the filter presses. The clay is removed from the press to the drying floor, heated by exhaust steam. To obtain high grade kaolin, such as that used in making paper, it is usually easy to get rid of grit by elutriation and settling in the washing troughs, vats, etc., iron being avoided by the proper selection of material. The chief trouble is often the presence of almost microscopic plates of mica, which the washing process often fails to eliminate, and which have to be removed by passing the wet material through a very fine silk mesh.

Cleaning a Varnished Map.—To remove dirt from a varnished map, rub the map with a damp cloth or sponge. Most of the dirt can probably be removed by placing the map on a table and rubbing stale bread-crumbs over it with the palms of the hands.

Painting Staircase hung with Wallpaper.—The course to be adopted in painting a staircase hung with wallpaper is as follows. The first thing is to remove the paper with water containing a little soda, and to rub down the walls afterwards with pumice-stone and water. Then fill up with distemper paint, and, when dry, rub down with glasspaper. Give two good coats of size, one hot and thin, the other chilled, to stop suction, make good any defective parts, and again glasspaper down. Coat with colour, nearly all oil and very thin, and follow with successive coats of paint until a satisfactory appearance is gained. Over distemper filling the first coat should be oily; over woodwork it should be flat—that is to say, it should contain a comparatively large quantity of turps.

Setting Out Frame for Wheelbarrow.—This is an easy method of setting out the frame for a wheelbarrow. Make a drawing of the plan of the framing, as shown

FIG. 2

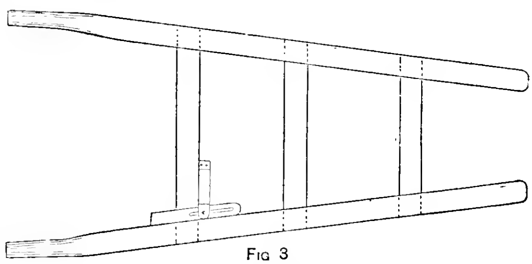


FIG 3

at Figs. 2 and 3, to a large scale, or full size. Next set a bevel to the angle of the mortises and shoulders as shown at Fig. 3. Then the exact length of cross-bearers or rails can be taken direct from the drawing, and the shoulders can be set out with the bevel as shown at Fig. 1.

Painting Concrete Surfaces.—For painting concrete, four or five coats of paint should be applied, the first and second coats of white lead well thinned with oil, and the later coats mixed with equal quantities of turpentine and oil. Every coat must be allowed to dry before the next is laid on; on no account should the concrete be painted before it is quite dry.

Measuring Land.—In ascertaining the contents of land, it is usual in measuring on a sloping surface to make allowance for the difference between the sloping length and the true horizontal distance, the latter being the length for buying or selling and for plotting on paper. There are various instruments and tables for giving this allowance, or it may be calculated thus: A fall of 5 ft. vertical in a length of 80 ft. on the slope would give a horizontal distance of $\sqrt{80^2 - 5^2} = 79{\cdot}84$ ft. A fall of 10 ft. in 180 ft. would give a horizontal distance of $\sqrt{180^2 - 10^2} = 179{\cdot}72$ ft. Usually, the measurements are taken with a chain of 66 ft., and an allowance per chain, according to the slope in degrees, is made by pulling the chain forward ¼ link, or whatever the requisite allowance may be, beyond the arrow, and then shifting the arrow forward.

Method of using Enamel.—Patent enamels should be used with the same precautions that are adopted in the case of any other enamel. Enamelling should be done in a warm room. Get a clean flat ground on the work, give one coat of enamel, and do not retouch it. If the first coat is not satisfactory, rub off the gloss, or flat it, because enamel should never be put on a glossy ground; then give another coat. Enamelling should not be done when the weather is damp or foggy.

Polish for Mangle Rollers.—To make a polish for the rollers of mangles and wringers use 1 pt. of methylated spirit, 2 oz. of gum sandarach, 2 oz. of seed lac, 2 oz. of gum benzoin, and 2 oz. of best beeswax. Dissolve the wax by gentle heat in sufficient turpentine to make a thin paste, and add it to the above after the gums are dissolved and carefully strained. Mix well together, and apply with soft flannel or a wadding pad as used by polishers. If the mixture is too thin, or seems a long time in giving a good result, or is to be applied by means of a camel-hair brush instead of pads, add more seed lac.

Design for a Small Porch.—The addition of a porch roof over the door of a workshop or tool house may be made both useful and ornamental. Figs. 1 and 2 illustrate a design in which the porch roof is covered with imitation tiles cut out of oilcloth. This porch roof is suitable for fixing over a door 3 ft. wide. The framework is made of yellow or red pine, 1½ in. square, of which 16 ft. will be required; the various lengths being cut off in accordance with the dimensions shown in Figs. 1 and 2. Only one side of the porch is shown in Fig. 1, the other side being exactly uniform. The horizontal piece is mortised into the vertical one, and wedged at the back, all the joints being closed with paint and secured by nails or screws. For cutting out the tiles, obtain some odd pieces of oilcloth of any pattern desired. Cut out of sheet zinc or tin a template of the pattern and size considered suitable, (Fig. 3), and from this template cut the tiles out of the oilcloth, care being taken to discard all pieces having holes in them. When a sufficient number of oilcloth tiles has been prepared—the roof under consideration requires fifty-five—paint them red on both sides, two coats; if only the upper side is painted, the sun and rain will cause them to curl up. Then nail them on to some thin wood, matchboard being preferable, using tinned tacks. Before commencing to nail the tiles down to the boards, a slip of wood ¼ in. thick, ½ in. wide, the length of the roof, must be fastened along the bottom edge to form an eaves plate, as shown at A (Fig. 1). Commence nailing the tiles on along the bottom edge, driving a tack in each top corner. The tacks holding the end tiles on each row must not be driven home, as it will be necessary to take these off in order to fasten the roof on to the framework. It is easier to paint the frame of the porch (giving it two coats) before fastening it over the door. After securing the framework in position, by passing nails or screws through the vertical posts, the roof must be placed in situ so as to have an equal overlap at each end, the loose tiles being temporarily removed for this purpose. The top edge of the roof can be neatly finished off by nailing on a strip of wood 1 in. wide, ½ in. thick, bevelled on the front edge, and painted to match the tiles. If the upper edge of the roof is in contact with a brick wall, it is advisable to flash the joint with sheet lead or zinc; but if the eaves of another roof pass over the door this flashing is unnecessary.

Details of Mariner's Compass. The compass bowl is suspended in gimbals in order to allow it to retain its horizontal position independently of the ship's motion. From the centre of the bottom of the bowl is a vertical steel-pointed pillar; the compass needle is fitted with a brass cap, in which is fixed an agate bearing that rests on the steel point. The compass card is divided on its edges into degrees, the degree circle occupying about ¼ in. of the card edge; the next circle contains the numerals of degrees marked from 0 at the north and south points to 90° at east and west. Thus the reading in degrees at sea is taken from the south point for the southern semicircle—*e.g.* what a surveyor reads as 120° the helmsman reads S.60°E. The points, thirty-two in number, are as follows. North, N. by E., N.N.E., N.E. by N., N.E., N.E. by E., E.N.E., E. by N.; East, E. by S., E.S.E., S.E. by E., S.E., S.E. by S., S.S.E., S. by E.; South, S. by W., S.S.W., S.W. by S., S.W., S.W. by W., W.S.W., W. by S.; West, W. by N., W.N.W., N.W. by W., N.W., N.W. by N., N.N.W., N. by W. These letters are printed radially towards their respective positions at 11¼° apart, which equals 1 point—that is, 360° ÷ 32. The central portion of the card is decorated with a star to help in distinguishing the points at a glance. The card is cemented to the needle and adjusted to hang horizontally by dropping sealing-wax on the under side where required; the glass lid screws on to the bowl, which is of copper.

Reducing Paper to Pulp.—Boil the paper with a solution of caustic soda, using some sort of stirring or beating arrangement to break up the felted fibres. It should then be turned into a tank and washed with water until free from alkali. If a flexible material is desired, add some soap to the pulp and boil, then add alum solution until the soapy feel has been destroyed; this will produce an alumina soap which will bind the fibres.

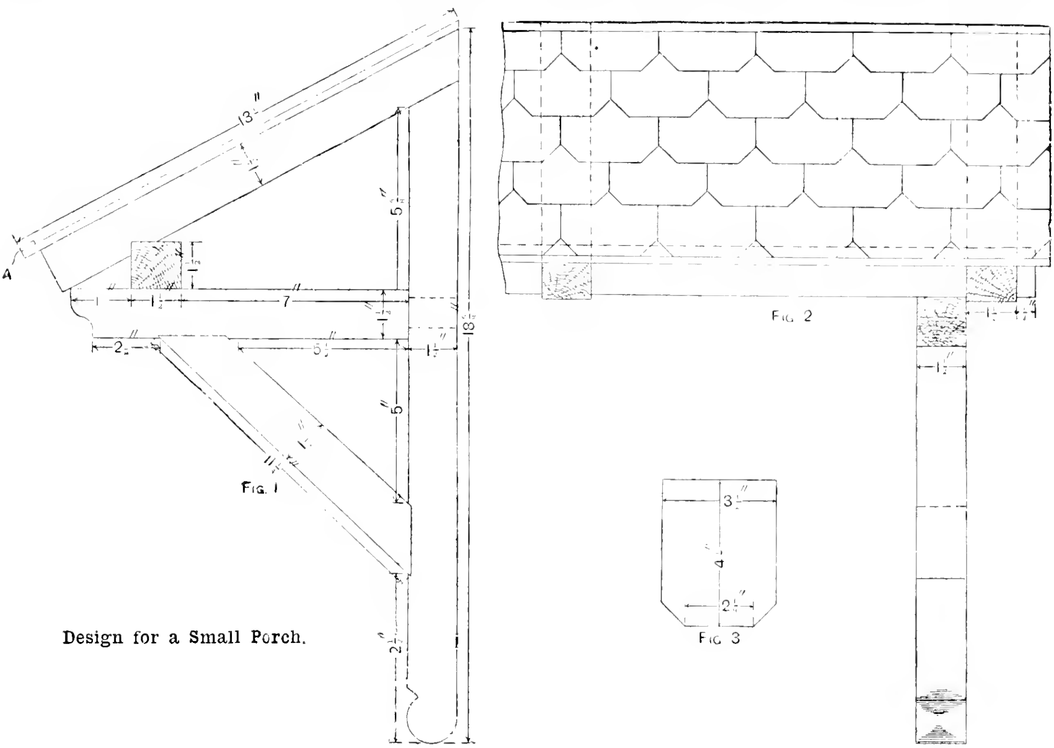
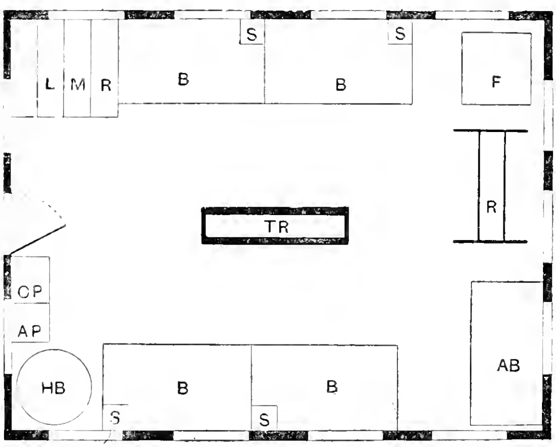


Fig. 1 Fig. 2 Fig. 3

Design for a Small Porch.

Chrome Tanning.—A chrome tanning bath is made, according to an American patented process, in this manner. Twelve pounds of chromic acid are dissolved in 6 gal. of hydrochloric acid of a specific gravity of 1·16; 50 lb. of chrome alum are dissolved in about 20 gal. of water; thirdly, 75 lb. of washing soda are dissolved in about 10 gal. of water. The soda solution is now slowly poured into the chrome alum solution until the result appears cloudy and a sparkling silver mist is seen on the surface, when water is added to make up the liquid to 44 gal. The solution is now run into the chromic acid solution and the whole allowed to settle. A 1½ per cent. solution of this liquid is used for the chrome bath (*i.e.* 1½ gal. of the liquid to 98½ gal. of water) for tanning, and the hides are hung in this. As the tanning proceeds, the strength of the bath is made up by more liquor to 4 or 5 per cent., and the temperature of the bath is kept at 80° F. When the thickest parts of the skins show a bluish-green colour, the tanning has proceeded far enough; the hides are then washed in water containing 1 oz. of borax in 20 gal. The time of tanning is for sheep-skins about one hour; goat-skins about one and a half hours; calf-skins two to four hours; and heavier materials ten hours.

Arrangement of Tinmen's Workshop.—A workshop of convenient size for four tinmen is shown by the accompanying diagram. The benches B, made of beech-wood, should be firmly built, and secured to the floor by iron brackets. Racks for small tools could be placed on the wall at the back of each bench, and the pipes from the stoves S carried to the chimney over the forge F.



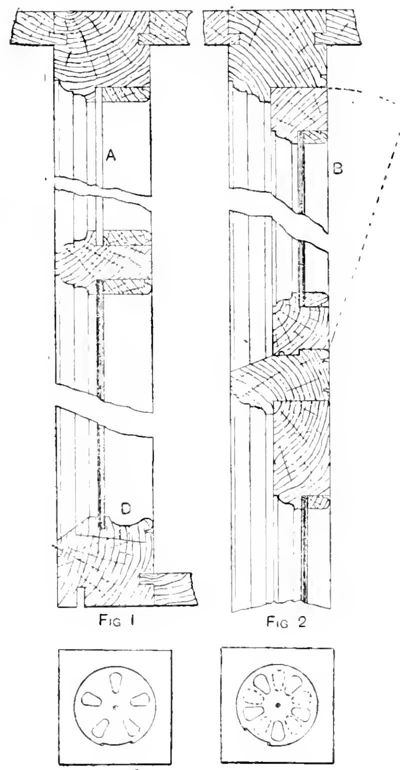
Plan of Tinmen's Workshop.

Hooks for carrying bundles of wire might be placed on the wall behind the rollers. The larger sheets of metal could be stood on their long ends in the racks L, M, and R, and the smaller plates in boxes on the top of the racks. The letter references not already mentioned are as follow: A B, angle bender; A P, ash pan; C P, coke pan; H B, hollowing block; R, rollers; and T R, tool rack.

Paint for Mirror Back.—The silvered back of a mirror may be protected by applying two coats of a mixture of ¾ lb. of red lead ground fine, 2 oz. of paper varnish, and 1 oz. of turpentine. Allow twenty-four hours to elapse before applying the second coat.

Dyeing Feathers.—Feathers are now dyed almost entirely with coal tar or aniline colours, these being very brilliant. Although most of them fade, some stand exposure to light extremely well. Previous to dyeing, all feathers should be soaked in a hot bath containing a moderate quantity of Castile soap, followed by a second bath of washing soda or carbonate of ammonia; these remove all grease and soften the feathers so that the dyes penetrate better. It is difficult to advise with regard to colours; experiment with the recipes that are given below. Cardinal: Boil 1 lb. of ground cochineal in 1 gal. of water, filter, and, while hot, steep the feathers for one hour; remove, add to the bath 2½ fl. oz. of tin solution, replace the feathers, and keep the bath hot for several hours. To prepare the tin solution, dissolve 8 oz. of tin in 6 oz. of hydrochloric acid and 3 oz. of nitric acid. For indigo, boil for half an hour in a bath containing 4 oz. alum, 2 oz. argol, and 1¼ oz. extract of indigo; run off half the bath, add infusion of 6 oz. to 9 oz. logwood chips previously made, and re-dye at a lower temperature (122° F.). Madder might be tried alone; it is, however, used principally in cotton dyeing, and the operation is a very complicated one. For saffron, use a tin mordant followed by an infusion of saffron. The latter substance is much too expensive to use for commercial dyeing. Turmeric in powder must be dissolved in methylated spirit, and the solution filtered; the feathers are then dipped in, removed, and dried.

Preventing Steam Condensing on Shop Windows.—The chief cause of steam condensing on shop windows is insufficient ventilation. In constructing shop fronts provision should always be made for an iron ventilating grating at the top of the sash as at A (Fig. 1); also for a fanlight over the door as at B (Fig. 2). The grating may be fitted with a hinged flap on the inside so that it can be closed when not required; the fanlight is hinged to the transom to fall inside on quadrants, or is fitted with gearing. The sill of the sash is prepared for the escape of condensed moisture (see D, Fig. 1); the bead which fixes the glass will intersect with the bead on the sill in the hollow, and from the outside a hole is bored and a zinc tube about ¼ in. diameter is inserted (see dotted lines); this will carry away any water that may collect and prevent it running on to the show-board. Figs. 3 and 4 show, open and closed respectively, a glass louvre ventilator for fixing on to the plate-glass in the sash; these ventilators may be effectually used when there is no ventilator at the top of the sash.

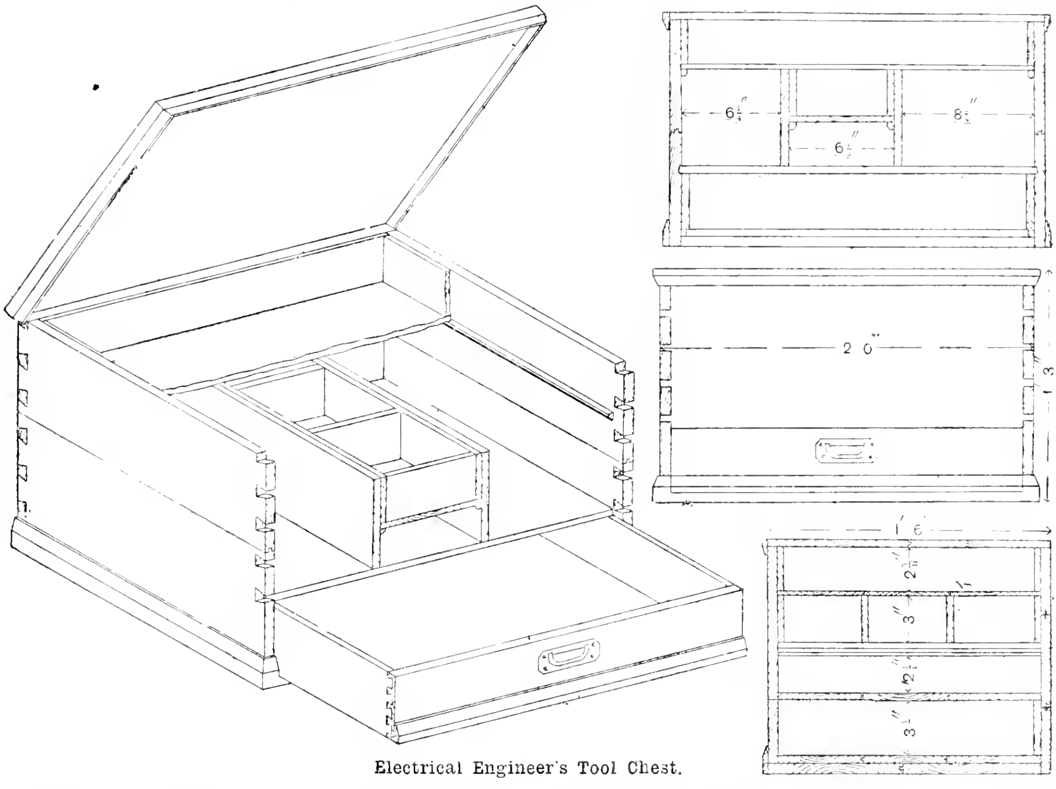


Preventing Steam Condensing on Shop Windows.

Staining Tonquin Canes.—The hard, crusty surface of canes renders them practically impervious to water stains. A brown tone may be gained by scorching the canes in a gas flame—a gas-stove flame for preference. Bamboo workers generally colour up the articles after they are made. This is done by mixing suitable pigments, as vandyke brown, brown umber, or black, with French polish or spirit varnish thinned out with methylated spirit, a coat of clear varnish being applied afterwards for finish. If the canes have been stored in a damp place to render them soft, try a stain made by mixing vandyke brown with American potash and hot water.

Rendering Wood Fireproof.—There have been a great number of compounds or mixtures proposed for fireproofing wood, fabrics, and other inflammable materials. Among the best of these may be mentioned ammonium chloride, ammonium phosphate, ammonium sulphate, alum, borax, boric acid, calcium chloride, magnesium chloride, sodium silicate, sodium tungstate, stannous chloride, and aluminium hydroxide. Any of these may be applied in solutions of 5 to 10 per cent. strength, except the last: aluminium hydroxide is formed as an insoluble substance in the fibre by soaking first in aluminium sulphate solution and afterwards in ammonia. Alum is very often used, and by some sodium tungstate is considered the best preventive of fire. A good mixture is ammonium chloride 15 parts, boric acid 6 parts, borax 3 parts, and water 100 parts, heated to boiling, and the wood or fibre plunged into it.

Electrical Engineer's Tool Chest.—The accompanying drawings show the construction of a suitable tool chest for an electrical engineer. The sides, lid, and bottom should be made of wood about ⅞ in. thick when finished; the trays can be of thinner wood, about ½ in. or ⅜ in. finished size. In the isometric view, part of the top tray is shown cut away, and also the front of the box, so as to show more clearly the construction of the interior.



Electrical Engineer's Tool Chest.

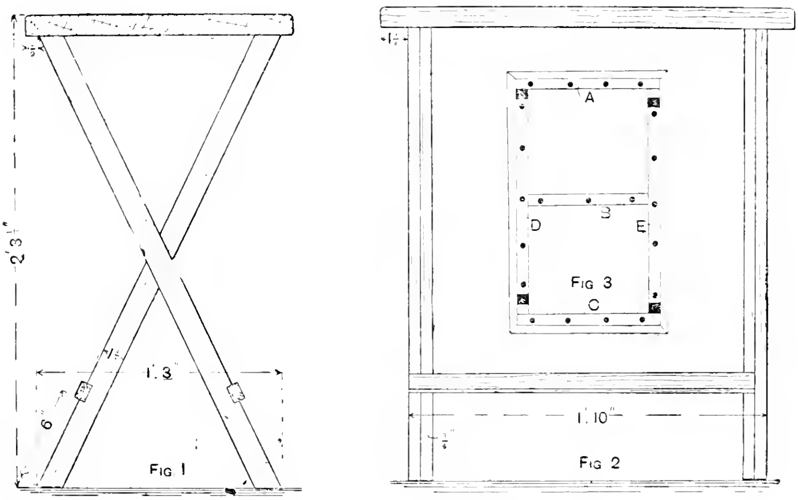
Clock Striking too Quickly.—To prevent the striking train of a clock running too fast, it is controlled by a "fly," which is a small fan fixed to the last pinion of the train. The fly should be sufficiently tight to turn when the pinion turns. If it is loose, the pinion is liable to run round quickly while the fly stands still and allow the clock to strike too rapidly. Therefore, see that the fly is tight upon its pinion. If it is, and the clock still strikes too fast, try extending the surface of the fly as much as possible by gumming paper to its edges.

Mixing and Preparing Mortars.—Often a wall has its strength estimated by the amount of power necessary to crush the bricks, instead of by the forces or influences that will render the mortar unfit for its purpose. The mortar should be made from the very best materials that can be obtained, as practically the strength of the mortar determines the strength of a brick structure. The lime should always be freshly burnt, as stale lime loses the power of setting firmly. For the very best lime mortar, hydraulic lime should be used, stone or grey lime being used in cheaper mortars. Hydraulic limes should be finely ground, otherwise they are liable to slake when they have been built in the work, and the swelling which ensues will crack and spoil the wall in which they have been used. Also hydraulic lime mortars must be used immediately they are made, as they set rapidly as compared with the stone or grey lime mortars. Chalk lime should never be used for building purposes, except in small sheds where cost prohibits the employment of a better lime. Chalk limes must not be used in making mortar for dwelling-houses. All limes before being mixed with sand should be thoroughly slaked. This is generally done by measuring out the required quantities of lime and sand, and forming with the sand a ring in which the lime is placed, water being added in sufficient quantities to slake the lime, and care being taken not to add more than is necessary. The slaking commences by the lime absorbing the water, and the swelling of its bulk, accompanied by hissing and giving off of steam, the purer the lime the more violent is the slaking process; hydraulic limes sometimes take hours to commence, while chalk limes start immediately. The sand is shovelled over the slaking lime, and the whole mass is left for a sufficient time, after which the lime and sand are thoroughly incorporated, making the required mortar. The sand used must be free from all earthy material, pit sand being considered the best; if the sand does contain organic or clayey matter, it should be washed before use. The proportion of sand and lime used in forming mortar are stated on p. 89.

Recipe for Branding Ink.—To make a branding ink, saturate water with 1 oz. of either gum tragacanth or gum arabic. Work up bone black into a stiff paste with the gum solution, and incorporate with a small quantity of soluble Prussian blue or indigo; add a few drops of creosote, and press into boxes. Glycerine may be used in place of the gum solution, and makes a very nice ink, but it does not dry very quickly. Another method is thoroughly to work up equal parts of soluble Prussian blue and lampblack or bone black with a little glycerine. Then make it into a paste of suitable stiffness with solution of gum arabic.

Making Upholsterers' Pom-poms.—One way of making the pom-poms used by upholsterers is to lap a wood or cardboard washer with three or four thicknesses of fibres, which may be of silk, worsted, or cotton. Cut all the fibres at the outer edge of the ring with a pair of pointed scissors: this will release the ring. Bind the tuft in the centre with fine silk twist, and trim the pom-poms to shape. Another method is to knock two smooth spikes into a board, say 1 ft. apart, wrap the materials round the spikes to the required thickness, and tie up every $1\frac{1}{2}$ in. Cut off in the centre of each tie, which will make eight pom-poms. Flatten with a blow from a mallet or by pressure. For fine work a rough creel could be fitted, and ten to twenty of the strands wrapped at once. A vandyked edge could be given to the pom-poms by trimming with a mattress tuft punch.

Light Table for Bedroom.—Figs. 1 and 2 are end and front views respectively of a light table that might stand by the bedside for the convenience of an invalid. For the ends, procure four pieces of wood each 2 ft. 6 in. long, and planed to $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. These are fixed permanently together in pairs with screws (not shown). Only two connecting bars are required, these being 1 ft. $9\frac{1}{4}$ in. long, planed to 1 in. by $\frac{3}{4}$ in. Fix these to the ends as in Fig. 1. For the foundation of the top obtain a board about 2 ft. long, 1 ft. 3 in. wide, and $\frac{1}{2}$ in. thick, either in one piece or by glueing two pieces together. This may be covered with oilcloth of the chequered Indian matting



Light Table for Bedroom.

pattern, which is easily washed, and which may be fixed down with thin glue. Fig. 3 shows how the bars on the under side are arranged. They are all of 1-in. by $\frac{1}{2}$-in. material. First glue and screw on those marked A, B, and C (Fig. 3), and then by long screws fix those marked D and E to the tops of the pieces forming the ends, shown by black rectangular patches. Now place the top in position and glue securely to the bars D and E, and screw from the under side. Run a piece of stop bead $1\frac{1}{4}$ in. by $\frac{1}{4}$ in. round the top and mitre it at the corners. This gives a good finish and prevents anything sliding off the table. Two coats of blue enamel paint may be given to the article; or, if made in hardwood, it might be polished.

Stump Moulding.—The term stump moulding is generally applied to ironfounding, in which parts of cast-iron are added to other castings or to wrought-iron work, as in bedstead work, where the cast-iron knuckles are cast on the angle-iron forming the side-stays. This operation is done in the same way as ordinary founding, by placing the part to be inserted in the finished mould and pouring the metal on it. In brassfounding the term denotes the method used in cock-founding known as plate casting. In this method the patterns are specially made and fixed on a metal plate in a frame, which is reversible. Instead of the moulding tub, use brackets on the wall or other stand in the shop. The mould is made to one side first by applying the peg-side and making the mould in the ordinary manner. The peg-side is removed, the plate frame is reversed, a hole-side is put on, and the other half of the mould is made. This method obviates making an odd-side. Probably an iron moulding machine, similar to those used in wheel moulding, etc., would be an assistance, as the moulds could be more quickly made by using machine pressure. If using the above-named machine, the pattern plate, which serves as the parting plate, has half the pattern projecting from each side, as previously stated. The mould is formed in sand contained in two moulding boxes which are placed on the pattern plate, one over and one under. The sand is pressed within the moulding boxes by the action of rams, which serve also, upon the removal of the pattern plate, to eject the sand moulds from the boxes. The advantage of the machine is that moulds may be made in one-eighth the time used in hand moulding.

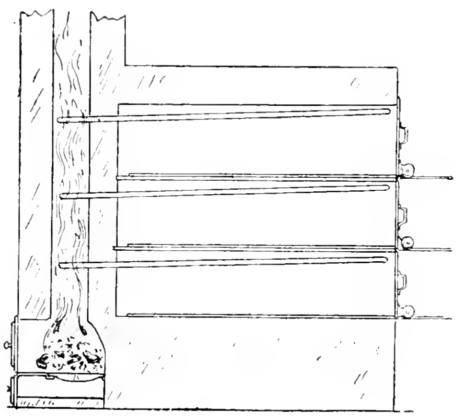
Preserving Clay Figures.—If the clay figures have been painted with ordinary oil paint it would be impossible to fire them, for the heat would immediately burn away the colours. Besides, the heat of an ordinary oven would have little effect on the clay except to dry it. To preserve modelled objects without casting, model them in plaster-of-Paris. A little glue added to the water when gauging the plaster will prevent it setting, with the result that the plaster may be handled like clay. Cream of tartar will also retard the setting properties of plaster. When quite hard, the modelled figure may be dipped in melted paraffin wax, so that it becomes susceptible of a high polish, and by the addition of certain pigments to the wax a colour may be imparted to the figure. For instance, a little yellow ochre will give the appearance of old ivory. Drapery may be represented by dipping strips of cloth in the plaster and arranging them on the figure. To judge the amount of size water to be used when gauging the plaster, dissolve some good glue in water and measure a certain quantity of this with a certain quantity of water. With the mixture gauge a small quantity of plaster to discover how long the mixture takes to set. Small clay models, if varnished, may be preserved for an indefinite time, but, being simply dry clay and not having been burnt, they are easily broken.

Colouring Gold Articles.—Gold alloys of not less quality than 15 carat may be made to assume the colour of fine gold by carefully boiling them in a mixture of nitrate of potash 15 oz., table salt 7 oz., alum 7 oz., and spirit of salts 1 oz. The work must be previously annealed and boiled out in aquafortis pickle, and wired with platinum wire. It must only be exposed to the colouring mixture for five minutes at a time, and well rinsed in boiling water between each operation. If 18-carat gold alloys are employed, the colouring mixture may consist of 1 oz. more of each of the above ingredients, omitting entirely the spirit of salts, and making the other powders into a paste with hot water. In all cases it is advisable to thin the colouring mixture with hot water as the process of colouring progresses, so as to avoid overdoing the work.

Making Red Stencil Ink.—Below are instructions on making a red stencil ink for marking boxes, etc. Get 3 lb. of pure pipeclay (not a mixture of pipeclay and whiting), and crush or scrape into a fine powder. Make a stiff mixture of Indian red in water, scrape a few shreds of soap into the Indian red, and mix well. Now gradually add the pipeclay until the mixture is of the consistency of putty. Then make it into cakes, and dry with gentle heat for use.

Determining Diameter and Pitch of Rivets.—For single riveting up to 1-in. plates the diameter of the rivet may equal one and one-fifth times the square root of the thickness of the plate, the rivet hole being one-twelfth larger. The pitch may equal 1·05 in. plus the diameter of the rivet hole. For a ¾-in. plate the rivet by this rule would be 1⅛ in. in diameter and the pitch about 2⅜ in.

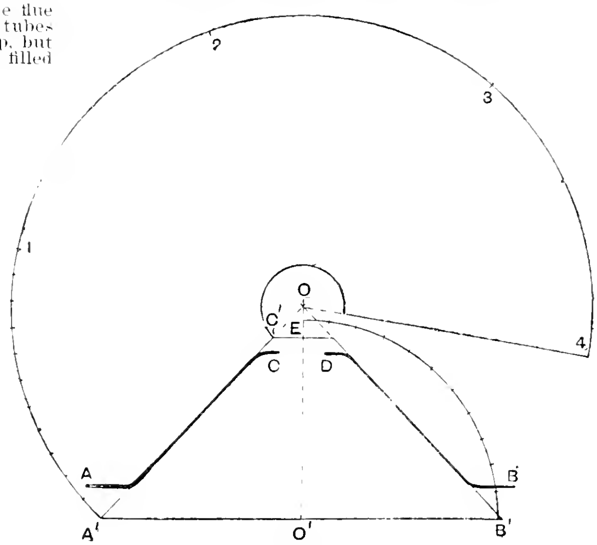
Baker's Steam-heated Oven.—The accompanying sketch shows the principle of improved decker ovens, heated by steam, for baking bread. It should not be taken as a working drawing, as the erection of such ovens must not be undertaken without previous experience, or working to a maker's particulars. The ovens are heated by a row of tubes running from back to front, the back ends starting from the furnace flue as shown, whence they slope upwards. The tubes are each separate and have their ends welded up, but previous to being closed they are about one-fifth filled with water. The sloping position of the tubes causes the water to come where the heat is felt, with the result that the tubes get quickly filled with high-temperature steam. It will be noticed that the furnace comes at the rear of what may be considered the front of the ovens, and all stoking is done away from where the preparation and baking are done.



Baker's Steam-heated Oven.

Chinese Lacquer Work.—The red gold and pale yellow effects seen on Chinese lacquered cabinets, etc., are produced by the aid of lead, tin, or silver foil laid upon a smooth surface, and coated with various gum varnishes. Very effective panels may be made upon this principle, and these may be utilised in the construction of screens, cabinets, etc. When sheet metal is used it should be perfectly free from marks of any kind, and should be highly polished. If wood is employed it must be planed very flat and then smoothed with fine glasspaper, being afterwards sized and primed with two coats of white lead and yellow ochre mixed with drying oil and a little oil size; rub down each coat with pumice powder and water. Next coat with flat black and rub down, first with finest sandpaper, then with a dry cloth, and finally with the palm of the hand, taking great care that particles of dust do not remain. Now give an even coat of a mixture of 2 parts of black japan and 1 part of gold size, and after rubbing down, when dry, with pumice powder and water the panel is ready for the silver leaf. The portions to be treated with foil are then coated with gold size to which has been added a small proportion of linseed oil, and when these parts are of the proper "tackiness" the leaf or foil is laid on, as in gilding. When dry and the surplus metal removed, the subjects are toned, shaded, and tinted; for the darker shades, dragon's blood mixed with turpentine is used; gamboge forms the lighter shades. All the transparent oil-colours, as used by artists, may also be used for various effects upon the foil. In say a landscape, the figures, sun, and water may be covered with foil, whilst the other portions of the landscape may be executed in oils, and should be suggestive rather than detailed. When dry, wash with water containing a very little soda, and finish by varnishing.

Making Wrought-iron Cone.—Below is explained how to make from ⅛-in. thick plates a wrought-iron cone of a rather pronounced slant. The lath being so great, the flange may be thrown off, and the seating at the small end of the cone worked in after the cone has been bent to shape and the seams made. To cut the pattern for a cone made in this manner, first draw an elevation of a section through the centre as A B C D. Produce the sides of the cone, and make the length to A B equal to the length necessary for the flange, and also make the length to C′ equal to the length to be worked in to form the seating. Where the lines produced intersect at O is the apex of the cone. Use this as centre, and with the radius O A′ draw an arc of a circle. Now divide the quarter circle O B′ E (using O B as radius) into any convenient number of equal parts, and set off a corresponding number of similar divisions on the curve of the pattern, as A′ 1. Now take the distance A′ 1 and set off from 1 to give the point 2; if a line were drawn from 2 to the centre O this would give one-half of the pattern. If it is found convenient to cut the pattern in one piece, set off two other divisions as 3, 4. Join 4 to the centre O, and then with O as centre and O C′ as radius, describe the arc of a circle shown to form the small end of the cone. The cone could be partly bent to shape in the rollers, and then worked round true upon a mandrel. Braze the seams, and then throw off the flange with a stretching hammer, working it to an arc of a circle first upon the mandrel, and then working it down flat afterwards upon the flat end of the anvil. The small end could be set in by working overhand upon an upright circular stake with the edge bevelled off. First tuck the metal in round the edge with cross blows from the stretching hammer, then set it in on the shoulder of the head a short distance down from the part first tucked in. Now work from this furrow up to the top edge, beating the metal over while working upwards to form the shape required. Again tuck the metal in at the top, and repeat the process described above until the work is brought to the desired shape.



Pattern for Wrought-iron Cone.

Re-blackening Thermometer Scales.—The best way of re-blackening the impressed figures and divisions of thermometer scales on boxwood is to use a drawing pen filled with japan black; this would of course be a rather tedious operation. Another method, but not so good, is to paint the boxwood scale all over with japan black, making sure that it enters all the lines and figures; then roll up a piece of smooth cloth into a ball, damp it with turpentine, and with this remove from the boxwood all the japan black with the exception of that in the depressions. This should not be difficult if the rubber is used gently and the impressions are deep.

How to Clean Engravings.—The following method of cleaning engravings has been found effective whenever dirt and faint stains were to be removed, though probably it is not so efficient as the chloride of lime process (described on p. 206) in dealing with stains of long standing. The specimen to be cleaned should, if possible, first be detached from its mount. Lay it face upwards on a clean, smooth board in the sink, or similar place, and sprinkle it with ordinary salt till thinly covered. Then take a lemon, cut it, and squeeze the juice over the engraving so as to dissolve the greater proportion of the salt. Then raise one end of the board to slant at an angle of about 25°, and flood it with nearly boiling water until all the salt and lemon juice are washed away. Drying must be allowed to proceed spontaneously.

Transferring Design to a Saucer.—If it is wished merely to fit the design to the concave face of the saucer, to be painted over by hand afterwards, fold up the drawing which it is desired to transfer as shown at Fig. 1 in such a manner as to fit the curved surface, and adapt the drawing to these folds. Fig. 2 shows the drawing arranged to suit the folds. Manufacturers, however, adopt a different method. Fig. 3 shows the pattern repeated three times round the circle. It will be noticed that the design does not entirely fill the circle, but that a small blank space has been left. In the necessary folding of the drawing to fit a circular concave surface the diameter of the circle on which the design is drawn must be considerably larger than that of the saucer—that is to say, in a saucer of 6-in. diameter, it will be necessary to draw the design on, say, a $7\frac{1}{2}$-in. circle. The spaces marked + + + in Fig. 3 are left vacant, so that there may be as little distortion as possible when transferring the printed pattern on to the saucer. Fig. 4 shows the appearance of the paper containing the design when stuck on the saucer. The following is the process employed in producing these designs. When a design has been drawn, the engraver cuts it out on a copper plate, making the incisions deeper where a darker shade is required. On to this engraved plate paint is rubbed to fill the lines, all superfluous colour being carefully cleaned off. A sheet of thin tissue paper is laid over the plate and pressed into it by means of an iron roller covered by three or four wrappings of felt. The print is then cut out with scissors, laid round the saucer, and worked into place with a dabber made of rolled flannel. The transfer is left on the saucer, which is in the "biscuit," or half-fired, state, for half an hour or so, when the paper is washed off, leaving the design on the saucer. In the colours composing the design there is a certain amount of oil, which stains the biscuit ware; this oil has to be burned off before the glaze is applied. This is done by placing the ware in a heated kiln. When the oily matter has been expelled, the saucer is dipped into the liquid glaze, which is a solution of borax glass containing lead salts and silica. The saucer will be dry in about five minutes, when it looks as if it had been whitewashed, the design being completely obliterated. The saucer is now put in an earthenware sagger, or crucible, and heated to a white heat for sixteen hours in the kiln, during which period the glaze has fused and turned into a transparent glass through which the design is visible. The saucer is now finished.

Polishing Ebony Mirror Frame.—Unless the ebony is of a particularly good quality there will be a brown or greenish tinge that should be overcome by wiping the frame with a good quality ebony stain, which can be bought ready made. The frame may then be finished by polishing with white or transparent polish. Or a combined ebony stain and polish may be used. This is made by mixing with the polish sufficient gas black or Frankfort black to gain the tone desired. An aniline spirit dye is used in most good shops, for the reason that it does not thicken the polish. In any case the best results are gained if the black is used thinly in the preliminary stages, and the final bodying up and finishing out are done with transparent polish. As ebony is a close-grained wood, no grain filler is required, and only a small quantity of polish. To apply the polish use wadding pads, slightly moistened with linseed oil.

Transferring Design to a Saucer.

FIG. 3.

FIG. 1

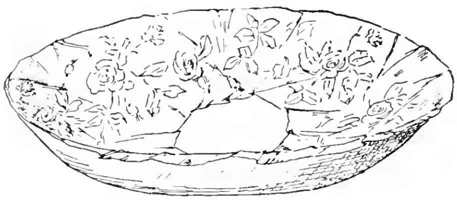


FIG 4

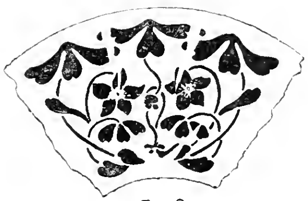


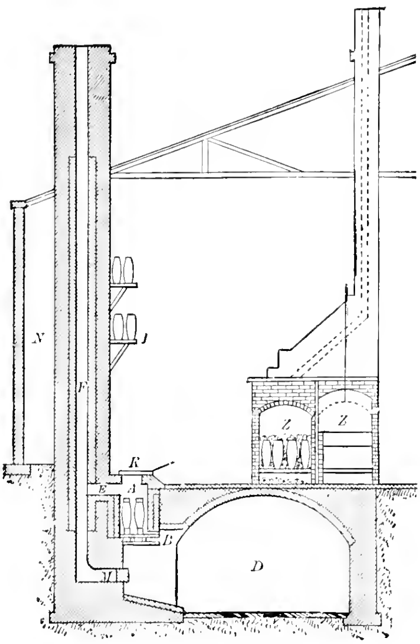
FIG. 2

Removing Varnish from Oak Carving.—To remove varnish from an oak carving a solution made as follows is used. Put equal parts of turpentine and methylated spirit into a stone jar and place the latter in a saucepan partly filled with water—glue-pot fashion. Put this in an oven and bring up to blood heat; then brush the solution over the carvings. As the varnish softens take it off with a nail brush. When all the varnish has been removed, apply several applications of oxalic acid—2 oz. to 1 pt. of water. Swill off with plenty of clean water, and finally brush over with common malt vinegar to kill any trace of acid.

Paint for Leather Trunks.—To paint leather black, first coat it with a solution of alum 1 oz., and water 1 pt. The next coat should consist of drop black $\frac{1}{4}$ lb., ground in turps, and terebine $\frac{1}{2}$ oz. Thin with turps. When this is dry give a final coat of drop black and Coburg varnish, mixed to the consistency of cream. For white paint use zinc white instead of black, and sugar of lead, ground fine, instead of terebine.

How to Fix Marqueteric Transfers.—Marqueterie transfers as used by French polishers for decorating furniture are fixed as described below. The design, with a fair margin of paper around it, is cut from the sheet, and is laid, face upwards, on a sheet of newspaper. A thin, even coat of good quality spirit varnish is then applied with a camel-hair brush and allowed to stand for a few seconds till the varnish becomes sticky. The design is then laid in the desired position, face downwards, and pressed well down so that all parts thoroughly adhere. After an interval of five minutes the back of the paper is damped with warm water and pressed down again. The paper is then saturated with water and allowed to stand for a few minutes, after which the paper should glide off, all surplus moisture being taken up with a clean moist washleather. The work is then set aside in a warm place. The best results are gained if the design is fixed after the work is merely bodied up. The subsequent bodying up and finishing will enable a fair body of polish to be applied, thus gaining solidity and appearance of inlay. To ensure accurate fixing of the design, tally marks should be made at its chief points, corresponding marks being made on the article to be decorated.

Crucible Steel Furnace.—The sketch herewith gives a sectional view of a crucible steel furnace. The melting chamber A should be 3 ft. high from the grate bars B, oval in shape, 26 in. by 19 in., and lined with 6-in.

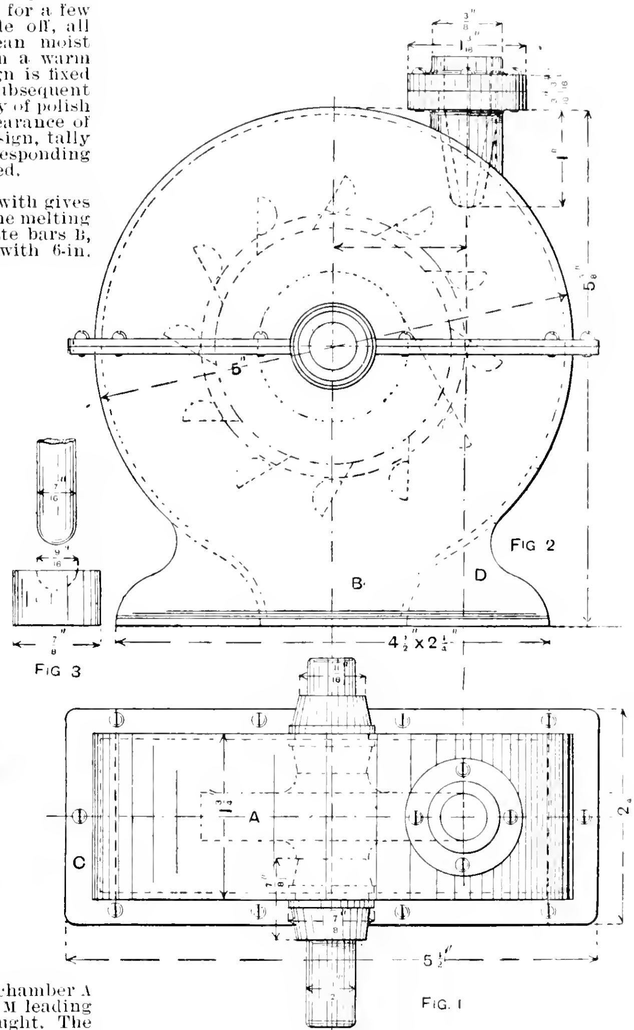


Crucible Steel Furnace.

ganister. The flue E leads from the melting chamber A into the chimney stack F. The cold-air flue M leading from the cellar D is used to regulate the draught. The chimney stack F, lined with firebrick, should be from 35 ft. to 40 ft. high. K is the cover of the melting chamber; I the shelves for drying crucibles; N the chamber behind the stack for drying crucibles, storing charcoal, etc.; and Z, Z the annealing ovens.

Recipe for Saddle Soap.—To make saddle soap, gently heat over a slow fire, constantly triturating till thoroughly incorporated, 1 lb. of beeswax, 8 oz. of soft soap, 2 oz. of linseed oil, and ½ pint of oil of turpentine; put in pots or tins. Rub a very little well into the saddle and polish with a soft brush.

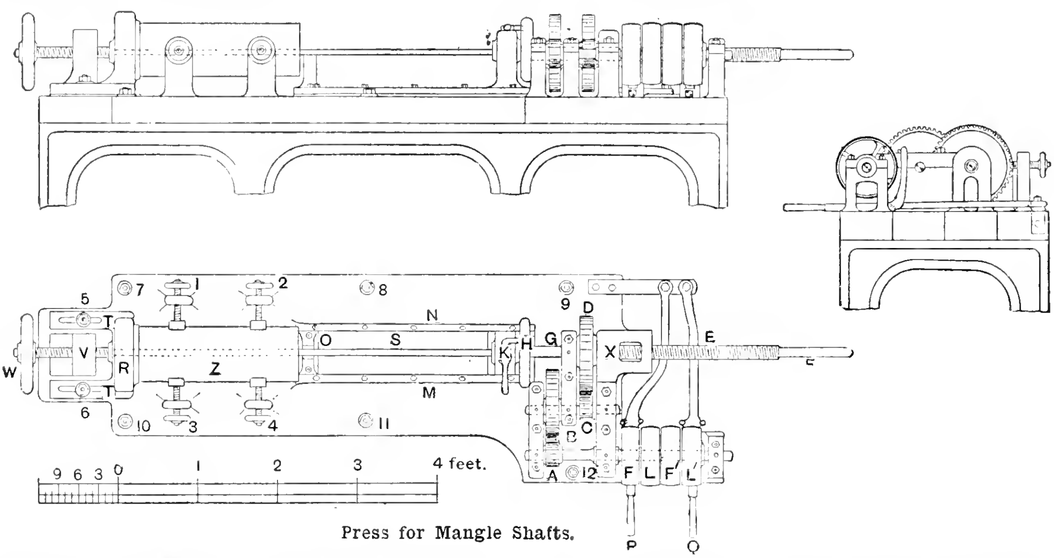
Small-power Water Motor. — The motor shown in plan by Fig. 1 and in elevation by Fig. 2 will develop ⅓ brake-horse-power with a fall of 30 ft. through a 2-in. pipe, and ½ brake-horse-power with a fall of 50 ft., the speeds being about 3,000 and 5,000 revolutions per minute. To make the wheel, get a brass casting A (Fig. 1) to be turned to 2¼ in. diam. by ½ in. wide. Fix centres in the disc and scribe a guide circle $1\frac{3}{16}$ in. in diameter; mark off twelve equal parts on the edge, and from these draw tangents to the guide circle. With a sharp chisel mark in the lines to about ¼ in. back from the rim, and mark lines across the rim joining the marking on both sides. Saw these lines in about ¼ in. with a sharp hack-saw, for receiving the cups. From $\frac{1}{16}$-in. sheet brass stamp the cups with the punch (Fig. 3) and trim off with shears. Then place the cups in position, tin the joints with a soldering bolt, and place the cup disc on a fire to sweat. Castings for the bearings should be turned to dimensions (see Fig. 1),



Small-power Water Motor

making the groove in the centre an exact fit for the $\frac{3}{32}$-in. sheet metal, of which the casing is constructed. Obtain a casting for the gland to which the nozzle is fitted, and turn this inside an exact fit for the nozzle. From ⅛-in. sheet iron cut out and bore the two flanges C (Fig. 1). The lower half of the casing is worked from $\frac{3}{32}$-in. sheet iron (blued). First cut out two pieces to shape B (Fig. 2). At each top edge file out a central semicircle exactly the diameter for the bushes. From the same metal cut two strips $1\frac{1}{16}$ in. broad and 6 in. long, and bend them to shape D (Fig. 2). Fix the whole of these parts by twisting thin wire round them and solder all together. The top cover is next made in the same way. The nozzle gland is then carefully fitted and soldered or brazed on. As a caution, do not make the nozzle of a high-speed motor more than ⅛-in. bore at the opening, but make it larger for a slower speed.

Press for Mangle Shafts.—The accompanying drawings show, with scale, a machine for pressing shafts in mangle rollers to be driven by steam. Two belts, one open and the other crossed, drive the pulleys F, L, F', and L', and by means of the striking gears P and Q the pinion A can be made to revolve in either direction, or the straps can be moved to the loose pulleys. As will be seen, the pinion drives the tooth wheel B, and the latter, being keyed on the same shaft as the pinion C, the tooth wheel D is driven in either direction as required. D has a thread cut in its boss and works the screw E, causing it to move backwards or forwards through the thrust block X. The plain parts of the screw shaft at F and G are for the purpose of preventing accident in the event of the striking gear not being moved quickly enough. Thus, when the tooth wheel D gets on the plain parts it will simply revolve without causing any movement of the screw: then the screw can be turned into the thread of D by the hand wheel H. It will only be at such times as these that the screw shaft will revolve, as the hand wheel H will be locked to the driving head K as indicated. The driving head K works between the planed sides M and N. The fixed head at O is simply for holding the mangle shaft S in position and for adjusting the mangle roller Z; this latter is held in position by means of the four cramps 1, 2, 3, and 4 as shown. The backthrust block R, with its slides T, T, can be moved backwards or forwards by means of the hand wheel W and screw working through the block V, and when adjusted can be firmly held to the bed by the two bolts and nuts shown at 5 and 6. The bed should be bolted to iron supports or other suitable foundation by bolts and nuts shown at 7, 8, 9, 10, 11, and 12.



Press for Mangle Shafts.

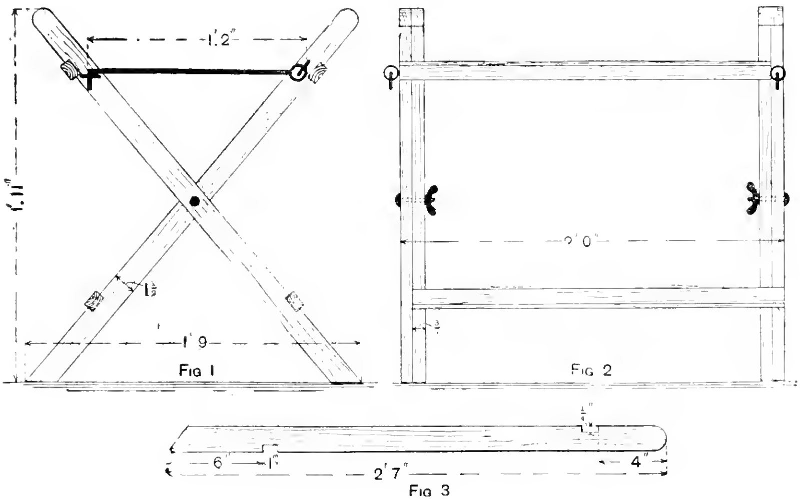
How to Polish a Coffin.—The following is a good method of polishing a coffin. Coat with linseed oil, and fill in with a paste of best Paris white (not plaster-of-Paris) and turpentine, coloured with yellow ochre for pitch-pine and oak, and with a mixture of brown umber and ochre for elm. A very small quantity of polish is mixed with this to assist it in setting. Rub the filling well in across the grain with a piece of coarse rag or a wisp of long tow, and then rub off all superfluous filler and leave it smooth and clean. The whole body of the coffin, including the lid, should be so treated, and should then be allowed to stand as long as is convenient—the longer the better. Another good filler is plaster-of-Paris, oil, and polish, but it is not so easily used, as it sets quickly; with this filler do only a very little at a time, or it will set and get muddy before it can be rubbed off. The polishing may be commenced as soon as the work is all filled in; start with the side first filled in. Make a big rubber of wadding, wet it well with polish, and cover with a piece of rag; put a little oil on with the finger and lay the polish on with long, straight strokes, not attempting to work it, but taking care not to leave any wet streaks. After two or three rubbers of polish have been applied begin to work it, but unless the coffin is panelled do not try circular work, but use sweeping strokes 3 ft. or 4 ft. long with a sort of twist at each end; do not scrub backward and forward over the same spot. Do not be afraid to use oil on the rubber at this stage. When a fair body has been obtained on one side, turn the coffin over and do the other, working the head and foot as well. When the second side has about as much polish as the first, turn back to the first side, and with very fine worn glasspaper remove any small lumps. If the filling is well done the grain hardly ever rises, except on damp or coarse-grained stuff; therefore the old plan of papering half the polish off to get the grain down is avoided by this method. Now quite body up a side—that is, as well as time and price will allow—and then finish it off, if the atmosphere is reasonably warm, with a few coats of very thin glaze. When this side is done satisfactorily, treat the other in the same manner, finishing the ends with the second side. The lid must be well bodied in and its mouldings glazed off, but the top should be spirited out. When a good body has been applied, wet the rubber with half polish, a sprinkling of spirit, and a little oil so that it works freely; continue to reduce the polish and oil, and increase the spirit, until a fair shine is obtained with the rubber marks showing in oil. Sprinkle a few drops of spirit on a rubber that has not been used for polish, and lay two or three thicknesses of clean rag over the face; rub this on the work until dry, then wet it again and repeat the process; after three or four such rubbers the surface should be well cleaned off and should shine well. If time presses, wipe over with a folded rag on which spirit has been sprinkled to clear the grease off more quickly, but, of course, not so well as by thoroughly spiriting out. If too cold to glaze, the body of the wood must be spirited out similarly, but the glaze saves time if it can be used. Always use a large rubber—one with a face as large as the palm of the hand—and do not let it get sodden; but, if necessary, pull it to pieces and tighten it up. For a panelled coffin, the above plan must be modified a little; a smaller rubber must be used, and great care must be taken to get into all the corners; the glaze finish is suitable for this also. Note the time spent on different portions of the work; a fair division would be to allow about two-thirds of time to the body and one-third, or rather more, to the lid, and take care that about equal time is given to both sides, as upon this a satisfactory result will obviously depend. First decide how much time may be allowed for the job, and then divide it up carefully and stick to it, or one part may look far better than another, a result certainly to be avoided.

Renovating Fur Necklet.—The only practicable method of renovating a fur necklet that is moth-eaten in parts is to cut away the latter. Open the necklet, remove the padding or lining, and place the skin, fur side down, upon a table. Cut out the spoilt part with a sharp knife on the skin side, taking care to cut only through the skin and not the fur below. Now cut to the required size a piece of skin of the same kind as that just removed, place it in position, and sew it in, being careful not to catch in the fur. If a spare piece of the skin is not to hand, sufficient must be cut from one end of the necklet, thus shortening it. A third alternative is to make the necklet of a different shape, neatly joining the small pieces cut off; probably there will then be sufficient to replace the spoilt parts.

Renovating Silvered Glass. To renovate a glass in one corner of which the silvering has assumed a frosted appearance, or has become spotted by damp, proceed in this manner. Cut out the affected silvering, first marking it off squarely with a straightedge and chisel; lay the glass flat on its face and apply either of the silvering solutions given on p. 108. Mix equal parts of (a) and (b), and pour upon the clear glass, allowing the solution to flow evenly over the bare place. Distilled water should be used, and the solutions should be kept in black bottles.

Soluble Prussian Blue used in Inks.—In many ink recipes soluble Prussian blue, which is a preparation of Prussian blue and ferrocyanide of potassium, is mentioned. This soluble blue is made thus. With a pestle and mortar thoroughly incorporate a quantity of ordinary Prussian blue with half its quantity of ferrocyanide of potassium. The mixture is then put into distilled water and thoroughly shaken from time to time; then it is allowed to stand and the sediment filtered off.

Folding Stand for Baby's Cradle.—Figs. 1 and 2 are end and side views respectively of a folding stand for a baby's cradle. To make the stand, procure four pieces of sound pine, ash, or oak, as preferred, 2 ft. 7 in. long, and plane them to 1¾ in. by ¾ in. These form the ends; set them out as shown at Fig. 3. Four pieces 1 ft. 11 in. long and planed to 1 in. by ⅝ in. will now be required for the connecting bars, the ends of which are seen in Fig. 1. The two pieces forming each end are pivoted together by a brass bolt 2½ in. long, with wing nut; the bars are fixed by light screws 1¼ in. long. To make the bars on which the cradle rests, heat one end of a piece of ¼-in. bar iron and form a ring on a stout screw eye. Bend the other end at right angles to fit into a corresponding eye, as seen in Fig. 1. When these bars are attached the stand is complete.



Folding Stand for Baby's Cradle.

Red Oil used in French Polishing.—In making the red oil used in French polishing, the alkanet root is merely broken into small pieces and the oil poured over. If well stirred up a reddish tinge will at once be imparted; leaving the root in the oil overnight will yield a stronger red. The red oil is usually kept in a large jar, more oil or root being added as required. The addition of a little turpentine assists in fetching out the colour if the root is very dry.

Mica and its Uses.—Mica is an anhydrous silicate of calcium and aluminium, and crystallises in a laminated mass, easily split along its axis; it can be subdivided down to $\frac{3}{1000}$ in. in thickness. Deposits of this material are found in various parts of the world. The occurrences of pockets in which mica is found cannot be predicted by the geological formation of the locality. The best quality mica is obtained from India, whence has been furnished the bulk of the world's supply for centuries. These mines, the principal of which is the Abruker mine, are in the interior of the country, remote from civilisation, and extremely inaccessible. Here the deposits are worked now as they were 2,000 years ago. The Abruker mine has been sunk about 200 ft., following the pitch of the vein, and all the mica and refuse are raised and carried away by natives. No machinery of any kind is used; drills and hammers are the only tools employed. The refuse and the mica are placed in baskets which each hold about 10 lb., and which are passed up from hand to hand by women who stand in a line on a ladder. When the top is reached the baskets are dumped and returned down the ladder in the same manner, but by another line of women. The crude mica is first roughly trimmed and then sorted into different grades, according to sizes and qualities. It is then split up, and the size to which it is to be sheared is marked upon it. After shearing, the mica is cleaned, weighed, and packed ready for transport. At the Abruker mine the packages of mica are loaded into carts drawn by bullocks, and carried in this way to seaports hundreds of miles away; the bullocks travel at the rate of about ten miles a day. There are many kinds of mica, prominent among which are Muscovite, the common potash mica; paragonite, an analogous soda variety; biotite, a magnesia mica having a black or dark green colour; phlogopite, a bronze-coloured mica found in crystalline limestone and serpentine rocks; lepidomelane, a black mica containing much iron; and lepidolite, the red-rose or lilac lithia mica. Mica has many uses, its chief perhaps being in the electrical industry. The fact that mica is elastic and fireproof, and that its insulating qualities are unaffected by time, has made it peculiarly adapted for use with electrical machinery. It has been used for vibrating plates in the photophone, and for diaphragms in telephone construction. In commutator work mica is almost indispensable, as also is the case in hundreds of other electrical machines and instruments. For the purpose of armature insulation in high-tension alternating machines mica is especially adapted; unfortunately the expense of the mineral has to a great extent prohibited its use. Mica waste has one or two electrical uses. Insulators are made by splitting up the mica into laminæ and solidifying these thin sheets at a high temperature and under a heavy pressure. It is claimed that this treatment increases the insulating properties of the mica. Mica replaces glass in positions exposed to much heat, is used in wall-paper varnish, and in packings for machinery; it has many other applications.

Making Glass Beads.—In making small glass beads, a portion of melted glass, coloured or uncoloured, is taken from the crucible upon the end of a long iron blowpipe; the melted glass is then blown into a thick bulb, to which another iron is attached exactly opposite to the first. The bulb is drawn out into a long narrow tube by two men, who pull the two pipes asunder. The narrow tube, many feet in length, is laid upon supports. The tube is cut into very short lengths to form the beads. If the beads are to be rounded they are either heated in an iron vessel kept in constant motion to prevent the beads adhering to each other while the edges just fuse, or they are revolved in a vessel with water, when the edges are rounded by mutual attrition.

Blackening of Silver Goods by Gas.—The coal gas used for lighting will sometimes cause silver and plated goods kept near the gas burners to become discoloured. This blackening is caused by the presence of sulphuretted hydrogen in the gas. No special form of burner will prevent the blackening of the silver if the gas is impure, though the use of an incandescent burner will lessen the evil, because a smaller quantity of gas will be consumed. If the sulphuretted hydrogen cannot be removed from the gas before it is sent out from the gas-works, a small purifier filled with slaked lime, through which the gas must be passed, should be fixed on the premises. This lime would remove the sulphuretted hydrogen. The spent lime should be removed from time to time, and fresh lime put in its place.

Brass Money Box.—To make a brass savings bank or money box (Fig. 1), cut a piece of sheet brass 11$\frac{1}{4}$ in. long by 4 in. wide. Clean it with emery-cloth, planish, bend it round over a mandrel, and braze the ends together, using borax as a flux. File the joint smooth, and raise two swagings on it, each to be 1$\frac{1}{4}$ in. distant from the ends. This constitutes the body. For the foot, cut a disc of brass 5$\frac{1}{4}$ in. in diameter, and hollow it on a block so that it resembles an inverted saucer. Swage this about $\frac{1}{2}$ in. distant from its edges, and cut a 2-in. hole out of the centre. Now file the edges perfectly plane, and solder the body on, having first fixed it in the centre. The top

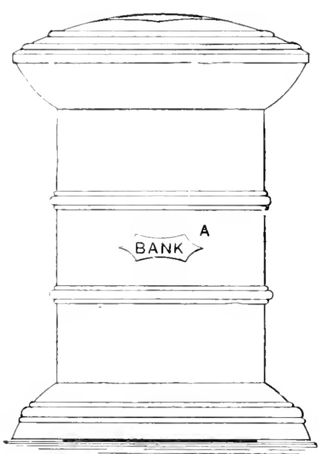


Fig 1

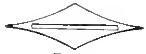


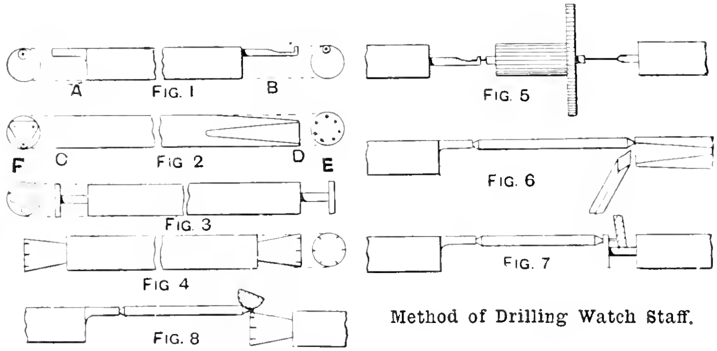
Fig 2

Brass Money Box.

is made by cutting two discs of brass each 5$\frac{1}{2}$ in. in diameter, and hollowing them together on a block, to resemble a shallow bowl. File the edges of these perfectly plane, and swage one about $\frac{1}{2}$ in. distant from the edge, afterwards jennying up a small edge. In this, the top hollow, cut a central slot to allow a large coin to pass through easily. Now file the bottom hollow, so that when an edge has been jennyed up it will fit tightly into the top. Cut a 3-in. hole out of the centre, and solder both hollows together, afterwards fixing the top over the centre of the body and soldering round. A small slot plate (Fig. 2) will show to better advantage if made of German silver. File it so that any coin can pass through easily, hollow it slightly to fit the top, and after fixing it in the centre solder it on. Now, if desirable, cut a name-plate A (Fig. 1) of German silver, and stamp or etch the name on; then fit it to the body, and solder it on. Cut a disc of brass about 3 in. in diameter, to be soldered underneath the foot over the 2-in. hole. When full, the bank can be emptied by unsoldering this disc, without in any way injuring the bank. Scrape off superfluous solder, and clean with emery and oil.

How to Bronze a Frieze.—Here are instructions on bronzing a Cordelova (imitation plaster) frieze. Apply to the frieze two coats of oil paint. For the bronze colour, mix in oil $\frac{1}{4}$ lb. of burnt umber, $\frac{1}{2}$ lb. of Brunswick green, and add Venetian red until a good bronze colour is obtained. A penny that has been in circulation for a year or two may be used as a colour test. Thin the colour with half varnish and half boiled oil, and give the frieze a good coat. On the following day, while the frieze is still tacky, apply bronze powder (copper, silver, or gold) to the parts of the frieze in relief. A paper-hanger's roller covered with plush can be used for this purpose. Run the plush-covered roller through the bronze and then over the parts of the frieze that are in relief. A white coat brushed over with knotting thinned with methylated spirit gives a good imitation of old ivory.

Using Watchmaker's Turns for Drilling a Staff, etc.—Below is described how to drill watch staffs for fine pivoting. The centres sold with a new pair of turns are of very limited use, so, when buying, a length of brass rod and a length of steel rod to fit them should also be purchased. From these rods proper runners for turning and pivoting balance staffs, etc., are made. The brass and the steel rods should be cut up into 3-in. pieces, each piece to form a runner. One steel runner, to be used as a back centre, should be filed up as at A (Fig. 1), and a minute centre marked upon it with a fine centre punch. This is for general use in turning staffs and pinions. The other end of the runner may have a hole drilled near its edge, and a brass pin B (Fig. 1) inserted in the hole; a small hole, through which a pivot can be passed, must be drilled through the thin end of the pin. This is a safety back centre to be used in turning a staff, cylinder, or pinion that has a fine pivot, which might break if its end rested in the centre A; by passing the pivot through the hole in B the strain of turning is taken by the shoulder of the pivot only. A steel runner should have fine centre punch dots round the end C (Fig. 2), as at E, and be filed to a triangle D at the other end, and have three centre dots as near the edge as possible as at F. These are for front turning centres for pivoting. The triangular end D is to be used for a very fine pivot, thus enabling the graver to get at the extreme end of the



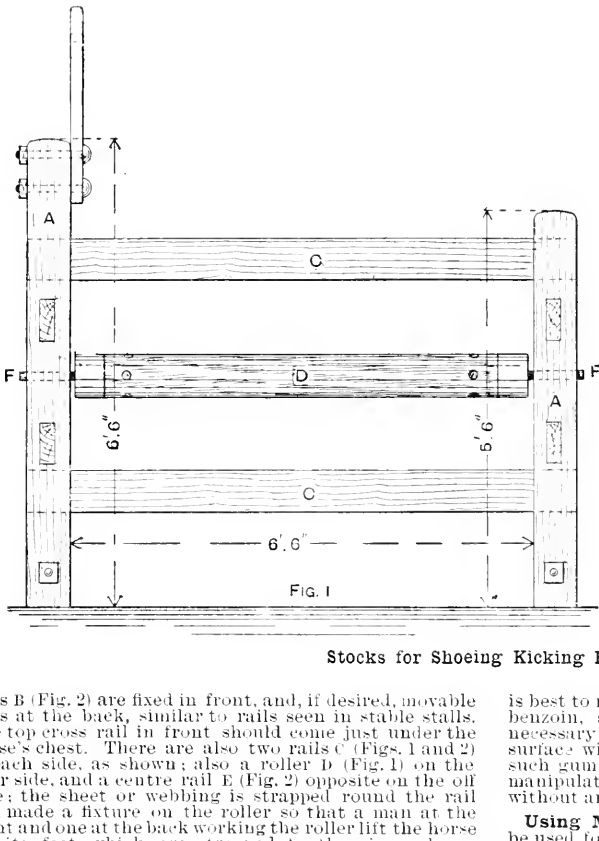
Method of Drilling Watch Staff.

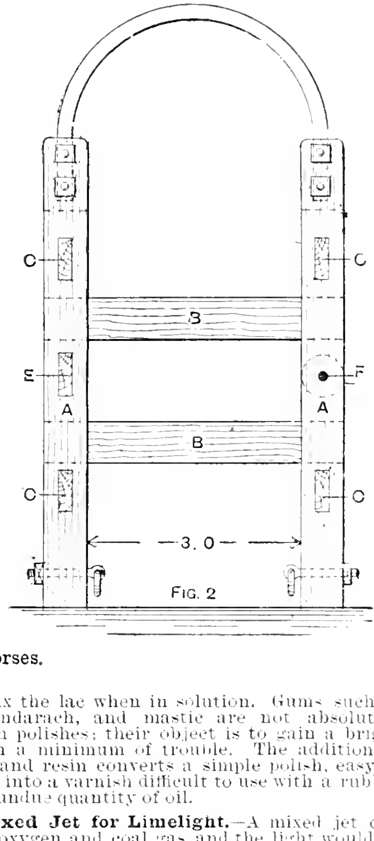
pivot. A brass runner should be filed at both ends, as shown in Fig. 3, small holes of graduated sizes being drilled through its end, through which pivots can be passed to round up and burnish their ends. Another brass runner should be filed at each end, as shown in Fig. 4, slight grooves in which pivots can lie during polishing with oilstone dust and red-stuff being made at the ends; one end should be kept for oilstone dust and the other end for red stuff. For drilling staffs and pinions, a central hole must be drilled in a brass runner and a short drill made and inserted friction-tight. The back pivot of the staff or pinion runs in a brass safety centre like B (Fig. 1), but in the centre of a runner. The work is revolved by a bow against the drill, which is held to it by the right hand, and slowly revolved to keep it true. Before drilling, the broken pivot is filed off flat, the centre carefully marked by a pointed chamfering tool, and care is taken that the drill is started in this centre. Fig. 5 shows a pinion being drilled with the parts in position. Fig. 6 shows a pivot being turned on a staff. Fig. 7 shows a pivot being rounded up with a file. Fig. 8 shows a pivot being polished by a steel polisher. In all these illustrations the bow and ferrule are omitted for the sake of clearness.

The Use of Fusible Plugs.—A fusible plug is a brass case containing a core of an alloy that will melt at a temperature a little higher than the heat of the water or steam in the boiler. It is practically impossible for the core to refuse to melt if the boiler runs sufficiently short of water to leave the plug exposed to the fire heat only, though, owing to ignorance, the plug might be placed where the fire could not readily act on it. If deposit inside the boiler covers the plug it may melt before its time. A fusible plug is also an element of safety when there is danger by excessive pressure, for as the pressure increases so does the heat of the water or steam, and when the latter reaches a temperature higher than normal the plug will act. Fusible plugs are, of course, no protection when a boiler is weak or develops defects in structure.

Fixing Handle of Walking Stick.—It is often required to fix the horn head of a walking stick or umbrella to an iron screw dowel that is firmly fixed in the stick itself, the joint being covered by a silver band. As a rule, the hole in the horn handle has worn too large for the dowel screw to grip, and if so a new screw of larger gauge is necessary. Screw the horn on the screw first. If the screw is tight and there seems danger of splitting the horn, warm the screw in a flame and screw home whilst hot, and then immediately immerse in cold water. There is no cement that will make a firm joint. A wooden plug might be tried, but it will be difficult to get the old screw into it, as the plug will probably wind out. Fill the silver mount with wax cement or sealing wax, and screw the handle up tight whilst the wax is fluid.

Stocks for Shoeing Kicking Horses.—Fig. 1 shows side elevation, and Fig. 2 end elevation, of a set of stocks for use in shoeing horses that kick. The ground is marked out to Figs. 1 and 2, and 7-in. square posts A are sunk in each corner. If the stocks are put up in a building or against a wall there must be clearance (say 2 ft. or 3 ft.) in front for the horse's head. Two cross rails B (Fig. 2) are fixed in front, and, if desired, movable ones at the back, similar to rails seen in stable stalls. The top cross rail in front should come just under the horse's chest. There are also two rails C (Figs. 1 and 2) at each side, as shown; also a roller D (Fig. 1) on the near side, and a centre rail E (Fig. 2) opposite on the off side; the sheet or webbing is strapped round the rail and made a fixture on the roller so that a man at the front and one at the back working the roller lift the horse off its feet, which are strapped to the rings shown at the bottom of the posts. The roller is turned with iron pins F (Fig. 1), like those seen on knacker carts. The bow seen at the top of the front posts is of iron.





Stocks for Shoeing Kicking Horses.

Blackening Brown Boots.—To blacken brown boots and shoes, first clean off all the dye with a strong solution of hot soda water, using a tooth brush. When the dye is removed, rub with a little black dye, which can be bought at most boot repairers' or grindery shops (a pennyworth will be ample). Allow this to dry, rub with a bit of pork fat, which makes the leather soft, and afterwards give the boot a good blacking and polishing.

Taking apart Photographic Lens.—The balsam used as cement between two photographic or other lenses sometimes assumes a sort of fungoid appearance. This, if slight, will practically make no difference to the working of the lens, but it may be removed as follows. Take the lens from its mount (and this removal may necessitate the turning up of the edge of the mount), and place it on a few thicknesses of blotting-paper in a beaker or saucepan. Pour warm water over the lens and keep warm for a time; this will soften the balsam, and the lenses may then be carefully slid apart. Note the positions of the lenses, so that in putting them together again the same sides of the lenses as before may face each other. Clean the lenses with benzole. Now place a lens, concave surface up, on a warm plate, and drop into it a spot of balsam free from bubbles, and lower upon it the convex surface of the other lens, and gently but firmly press well together till the excess oozes out. Put in a clamp or bind up together until dry. On heating, the balsam should remain hard. On re-setting the lens, the fungoid appearance will most likely have disappeared.

Gums used by French Polishers.—Shellac forms the foundation of most polishes and spirit varnish. Garnet lac is a very dark variety useful for "black" or varnish for japanning purposes. Orange shellac has many grades, from common to best. Lemon shellac is for best work. White or bleached shellac is used for decorative work, such as polishing inlaid work and fancy woods that are to be kept light in colour. It is best to mix the lac when in solution. Gums such as benzoin, sandarach, and mastic are not absolutely necessary in polishes; their object is to gain a bright surface with a minimum of trouble. The addition of such gums and resin converts a simple polish, easy to manipulate, into a varnish difficult to use with a rubber without an undue quantity of oil.

Using Mixed Jet for Limelight.—A mixed jet can be used for oxygen and coal gas, and the light would be about the same as a blow-through jet with the same gases. The hydrogen should be rather more than 2 to 1 of oxygen, and the best proportion is being used when the best light is obtained. With coal gas and oxygen, use about 10 of gas to 8 of oxygen; here, again, turn on the oxygen till the best light results. If oxygen cannot be obtained at a definite pressure from a bag, fill a bag with coal gas also, and leave both in a double set of pressure boards under the same pressure. Failing this, the pressure of oxygen will commence at 9 in., and will gradually fall to nothing. With an oxygen cylinder the pressure can be regulated to about that of the gas. For preparing oxygen, 2 parts of chlorate to 1 part of oxide of manganese are heated in a retort. Wright recommends 2 lb. of chlorate to ½ lb. oxide of manganese and 6 oz. of common salt, because the oxygen comes off from this mixture very regularly. 1 lb. of the first mixture yields about 4,800 cub. in. of oxygen, and 1 lb. of the second mixture yields about 5,000 cub. in. To compress the mixture, powder and moisten it with water first.

Mechanism of Perpetual Calendar Watch.—Fig. 1 shows the arrangement of a perpetual calendar dial. At the top is the month hand; on the right is the date hand; on the left is the day-of-the-week hand. Inside the seconds dial is the moon disc, showing by observation or by the numbers the age of the moon. Fig. 2 shows the mechanism underneath the dial. D is the moon disc. It has two moons, and around its edge are fifty-eight teeth, going round once in two lunar months. It rides loose upon a central pipe, and is driven, one tooth each day, by a pin in the wheel E^1, driven in its turn by the wheel F. F is on the hour wheel of the watch, and goes round once in twelve hours; it has forty teeth. It drives the wheels E^1 and E^2, having eighty teeth each, and going round once in twenty-four hours. The wheels E^1 and E^2, by means of pins projecting from them, as shown, drive the day-of-the-week wheel B and the date wheel C one tooth each day. B has seven and C has thirty-one teeth. The day-of-the-week hand is fastened to the axis of B, and the date hand to the axis of C. A is the month wheel; it has forty-eight teeth, and goes round once in four years. It is driven by the intermediate wheel G, driven in its turn by the date wheel C. Upon A is mounted a steel disc having notches of varying depth in its circumference. Thus, the space representing the month of January is high; February is a deep slot, as it is three days short; March, again, is high; April is a shallow notch, being one day short; and so on. It will be noticed that three Februaries are deep notches (three days short, or twenty-eight days), and one February is not so deep, being two days short, or twenty-nine days in leap year. The lever H, a finger on which enters these notches, regulates the number of days shown for each month by operating on a projecting pin on the date wheel C. The position of the lever H with regard to the wheel C varies according to whether its finger piece rests in a deep or a shallow notch of A. Thus, when resting on a high space, or a thirty-one-day month, the cam shown on C passes the lever without disturbing it at the end of the month. But when the lever H is resting in a notch, it projects farther over C, and the cam comes in contact with it one, two, or three days, as the case may be, before the end of the month. The pressure on the cam causes the pin in C to rise and come in the path of the lever H, as the latter is drawn back each day by the impulse pin in E^1 acting on the arm I. Each day when the arm I is released, H springs forward again and ordinarily does nothing, as there is no projecting pin on C; but after the cam on C has come in contact with H, the impulse pin C is caused to rise, and the lever H coming forward forces C round for several teeth. The wheel C is a delicate piece of work. There is a connection between the cam upon it and the impulse pin upon which the lever H acts. The connection is underneath the wheel, and consists of a spring lever. The effect is that, as soon as the cam presses against the end of H, the impulse pin rises from the level of the wheel and stands up in the path of H. It remains in this position until about the middle of the month, when it comes into contact with a fixed stud under C, and is restored to its normal position level with the surface. The lever H is kept up to A, and caused to return, when drawn back each day, by a steel spring, as shown. The month wheel A, day-of-the-week wheel B, date wheel C, and moon disc D are all held in position by spring flirts resting between their teeth, and causing them to jump one tooth accurately each time they are moved. This is but one of many forms of perpetual calendar movements. All are complicated and difficult to make, and even when properly made frequently give trouble.

Curing Birds' Skins.—A preservative used in curing birds' skins consists of $1\frac{1}{2}$ lb. of whiting and $\frac{1}{4}$ lb. of soft soap boiled in 1 pt. of water, with the addition of $\frac{1}{8}$ oz. of chloride of lime and $\frac{1}{2}$ oz. of tincture of musk. This recipe works out at less than a farthing for a starling or blackbird. Instead of musk, tincture of camphor might be used; it is a little cheaper but not so good. In using the preservative it is painted on the inside of the skins; then the "stuffing" is done.

Polishing Ebony Fretwork.—The polishing should be wholly or three parts done before the fret-cutting is begun. After sawing the wood, fix it to a firm flat bench and plane the surface smooth; then proceed with the cutting, drilling the entering holes for the saw from the face. Ordinary work may be finished by using various grades of emery cloth down to a fineness of 00, the final polish being given by briskly rubbing with a hard brush on which has been placed a little beeswax. Or the following process might be tried. Wrap the emery cloth tightly round a piece of cork 1 in. by 2 in. by 1 in., and rub up and down with the grain of the wood. Great care must be exercised so as not to break off any portion of the more delicate fretwork, and change the grade of the emery cloth as the surface gradually becomes smoother. Should it be preferred the surface may be lightly French polished, using silk for the outside of the rubber in place of ordinary cotton; silk will last longer over the sharp surface of the fretwork.

Photographic Vignettes.—Flashed glass is used for making photographic vignetting glasses, the colour being removed from the centre by rubbing with hydrofluoric acid. The operation is a messy one, however. Cardboard is by far the most convenient material to use for making vignettes, as a fresh one has generally to be cut for each negative. It is not necessary to keep a card vignette moving whilst the negative is printing. The usual plan is to shape the vignette according to the density of the different parts of the negative, to fix it at a greater or less distance from the negative, and, if necessary, to cover it with tissue paper. Many failures have been due no doubt to fixing the card too near the negative; it should be more than $\frac{1}{4}$ in. away, and should lap over where the negative is thin, for there the light will spread rapidly. Sometimes it is advisable to tuck a little cotton-wool under the vignette, giving a loose edge to the wool to avoid a hard line. To make a successful vignette by any method the background must be light; but vignetting is old-fashioned and seldom artistic, and should be avoided if possible.

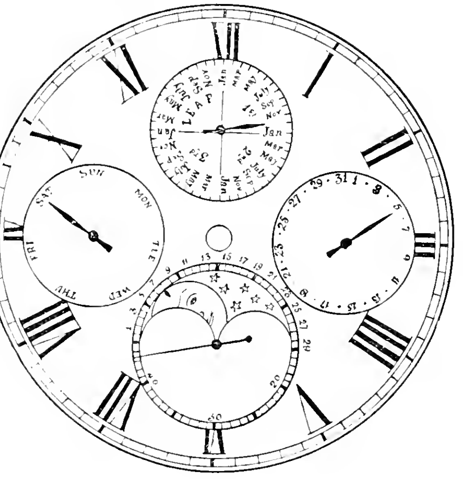


FIG. 1

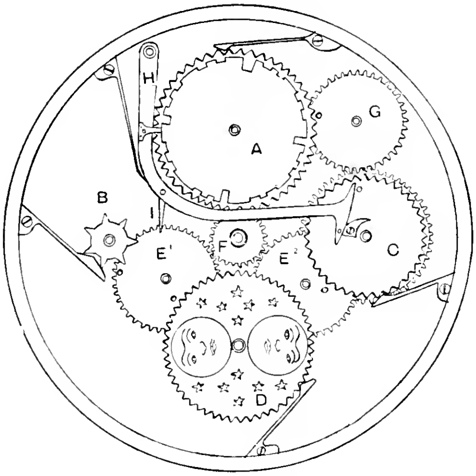


FIG 2

Mechanism of Perpetual Calendar Watch.

Enamelling and Polishing Slate.—The slabs of slate are cut to size, shaped, moulded, carved, or incised as may be required, then polished with sand and water to a fine surface. The enamel is then carefully and regularly laid on, or the slab is marbled to a design, then stoved in an oven capable of being heated to 350° F. Some colours require less heat than others. The time necessary for stoving depends on the colour: experience will teach this. The colouring is then polished with rottenstone and sand and, when a very fine finish is required, completed with the hand.

Pattern for Conical Rim.—It is assumed that a copper hoop is to be put round a wooden bucket to ornament it. Below is explained how to draw a plan to which to cut the copper so that it will fit snugly to the shape of the bucket. The pattern wanted is a frustum of a right cone, and to set this out to the correct taper first draw a semi-elevation of the bucket as A B D C (Fig. 1). Next draw the position of the rim F f^1 e E, and from E draw a line E f at right angles to E e, and draw F f^1. With f^1 as centre, and with f^1 F and f^1 f as radii, draw quarter circles F L and f l to represent a quarter plan of the rim. Divide these quarter circles into an equal number of parts, as F, G, H, f, g, h, etc. Join F f, G g, etc., and also join F g, G h, etc., by dotted lines as shown. The lines F f, G g, H h, etc., will be the plans of a series of slants of the cone, and the dotted lines F g, etc., will be the plans of a series of diagonals. F E is the slant of the frustum, and to find the slant of the diagonal draw a line g m at right angles to the dotted line F g, and make g m equal to the line E f. Draw F m, which will be the true slant of the diagonal. To work the pattern, take the length F E and set off on a straight line as F f on the pattern (Fig. 2). Now take the true slant F m (Fig. 1) of the diagonal as radius, and using F (Fig. 2) as centre, draw arcs to cut g g on each side of the centre line. With f g (Fig. 1) as radius, and f (Fig. 2) as centre, cut the arcs first drawn. Again use the slant F f (Fig. 2) as radius, and with the intersecting arcs g g as centres, describe arcs at the top of the pattern (Fig. 2). With F G as radius, and F as centre, cut the arc last drawn. Repeat this method of working for each division on the plan (Fig. 1), using the small and large divisions and slants and diagonals in their proper order, and make the number of divisions on the complete pattern equal to four times the number on the quarter plan; or if the rim is made in two pieces the divisions would be as shown by the accompanying patterns.

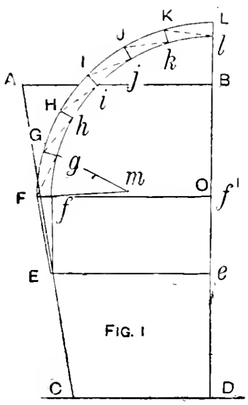


FIG. I

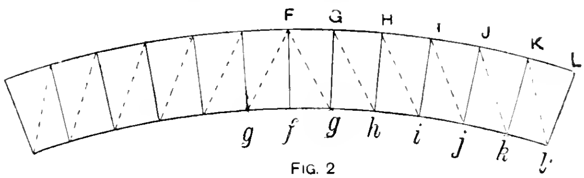


FIG. 2

Pattern for Conical Rim.

Making Shaving Paste.—Shaving pastes are made, as a rule, from fine soft soaps composed of potash and lard. To make creme d'amande, dissolve 1 lb. of caustic potash in 1 pt. of water. Melt down in a pan 3 lb. of lard and add to it gradually the potash lye, stirring thoroughly during the addition. Boil and stir well for some time, and continue adding the lye until the mass becomes pasty, and a small portion taken from the pan works smoothly and free from greasiness when it is dipped in water and worked between the fingers. The addition of the lye may then be stopped. Beat the soap in a mortar and with the pestle till it is cold, when it will have a satiny appearance. Add sufficient essence of almonds during the beating.

Making Albumen Paper.—Albumenised printing-out paper is made by coating a suitable paper with albumen containing a soluble chloride. Rives paper is generally employed, and what is known as 10 kilo should be chosen. Most of the albumen used commercially for this work is obtained from the blood of animals, but a small consumer will find egg albumen more suitable. The albumen of one egg will coat two sheets of paper, but to cover the dish that must be used to the depth of about ¼ in., about twenty eggs will be required. The paper may be coated in quarter sheets. The whites of the eggs must be thoroughly separated from the yolks, no trace of the yolks being in the coating solution. Tap the shell on the edge of a cup to crack it, hold the crack uppermost, and, placing the thumbs in the crack, pull in two and pour the yolk from one half shell to the other. While this is being done, the white will of itself fall into the cup below. Pour the whites one by one into a deep vessel, add 8 gr. per ounce of ammonium chloride, and beat to a froth with an egg whisk or a bundle of quill pens. Allow the mixture to settle till next day, filter through fine muslin, pour into a flat dish, and, to coat the paper, which is more easily done if it is slightly damp, float it on the solution, lowering the paper at one corner, and pushing it forward along the dish until the whole surface is in contact. Care must be taken to avoid air bubbles, as such spots cannot be sensitised. If the paper is at all dry it will curl back off the solution. The paper may be tinted with Judson's dyes, if desired. For double albumenised paper, immerse after the first coating in a solution of 4 parts methylated spirit and 1 part water, then give a second coating of albumen. The paper is sensitised just before use by floating on a solution of silver nitrate 50 gr. to the ounce.

Defects of Gas-meters.—When the floats of wet gas-meters are being soldered together, the air inside the floats becomes rarefied owing to the increased temperature caused by the heat of the bolt used in soldering. When this inside air is cooled by the water in the meter, the pressure of the outside air upon the float becomes so great that any sudden slight increase of pressure will frequently overcome the resistance of the metal, which is only soft pewter. Floats should always be made with egg-shaped ends instead of flat ends, so as to offer more resistance. In dry gas-meters the faces of the hard white metal valves sometimes become coated with a deposit, caused probably by the action of the gas on the oil used to keep the diaphragms soft. In course of time this deposit hardens until the pressure of the gas is insufficient to move the valve cover. The top of the meter and the top of the valve-box inside should be taken off, and the valve covers taken out and thoroughly cleaned with a little naphtha, the faces of the valves being treated in the same manner; the meter should then be put together again and be re-tested and stamped by an authorised inspector. The only remedy is to soften the diaphragms with an oil that is not affected by the particular gas in use.

Manufacture of Lucifer Matches.—The tipping composition for "strike-anywhere" matches consists of red phosphorus with other ingredients as follow. (1) Phosphorus 1 part, chlorate of potash 8 parts, glue 4 parts, whiting 2 parts, powdered glass 8 parts, water 22 parts. (2) Phosphorus 2 parts, chlorate of potash 5 parts, glue 3 parts, red lead 1½ parts, water 12 parts. Safety matches have no phosphorus on the tip, but it is contained in the rubber. For tipping safety matches, use (1) Chlorate of potash 1 part, glue 2 parts, sulphide of antimony 1 part, water 12 parts. (2) Chlorate of potash 4 parts, bichromate of potash 1½ parts, red lead 4 parts, sulphide of antimony 3 parts, with sufficient glue and water to form a paste. The rubber on the box is treated with phosphorus 2 parts, powdered glass 1 part, mixed with sufficient glue solution to form a thin fluid while warm. Red phosphorus varies in colour from red to brown; it is formed by heating the ordinary phosphorus to 240° C. or 250° C., either in a closed space or in an inert gas, such as nitrogen or carbonic acid. On heating the red modification to a temperature of 260° C. it changes back to the ordinary phosphorus. Red phosphorus, when freed from the ordinary phosphorus, is non-poisonous, passing through the body unaltered; but red phosphorus is rarely, if ever, free from ordinary phosphorus, and hence cannot be said to be non-injurious. Red phosphorus does not take fire by simple friction like the yellow variety, but must be raised to a temperature of 240° C.

Lenses for Magic Lantern.—Plano-convex lenses are generally used in magic lanterns, two to each condenser, with their convex sides towards each other. The smallest condensers used are 4 in. in diameter, and this is none too much, as the slide pictures are supposed to be 4 in. in diameter. A single lantern should have a condenser not less than 4¼ in. in diameter. Biunials and triples require 4½-in. condensers to allow for the rolling of the curtain, and also a little margin to get the two or three discs coincident on the screen. For the objective, the following lenses are required:—The front combination consists of a double convex lens and a plano-concave lens cemented together. These should be 1½ in. to 1¾ in. in diameter. The back combination has two lenses separated by a short space; the one nearest the front is a meniscus, with the convex side towards the front, and the other is a double convex lens of unequal curves, the curve with the longer radius being placed nearest the light. These lenses should be 2 in. in diameter. An objective of this description has a focus of about 6 in. and gives the best results. When, however, an objective of very long focus is required, a single achromatic answers nearly as well; but it must be sufficiently large to take all the rays of light. A single lens of 12-in. focus should be at least 3 in. in diameter.

Constructing a Bamboo Bedstead.—Fig. 1 shows the foot of a bamboo bedstead, 3 ft. wide and 3 ft. 10 in. high; Figs. 2 and 3 are alternative designs for the head. The framework of each of these sections must be made from canes 1¼ in. to 2 in. in diameter, and great care

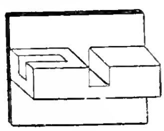


FIG 4

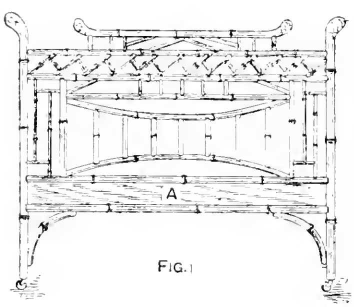


FIG. 1

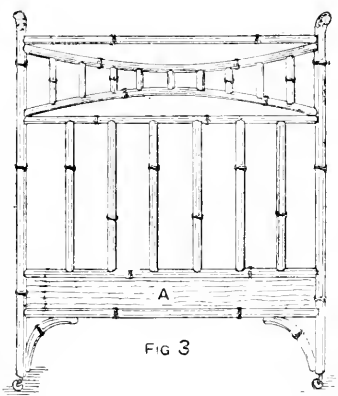


FIG 3

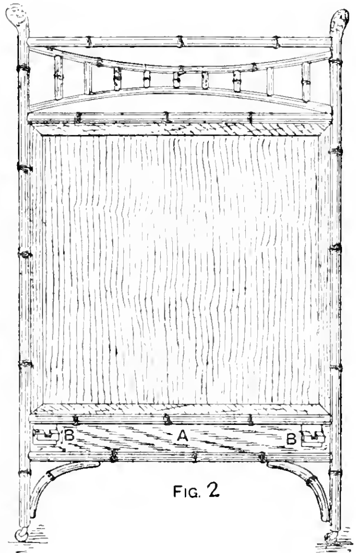


FIG. 2

Constructing a Bamboo Bedstead.

must be taken in making the joints and seeing that the dowels are a good fit. A (Figs. 1, 2, and 3) is a piece of beech 7 in. wide and 1¾ in. thick. This must be fitted in position 1 ft. above the ground before the filling work is commenced, and should be securely fastened with round-headed screws passed through the legs and cross rails into the wood. The strength of the bedstead in a great measure depends on the firmness of this piece of wood, as on it are fastened the angles by which the head and foot are stretched. The filling work can next be proceeded with, care being taken that every joint is strong and a perfect fit. Fig. 2 shows a design suitable for an upholstered back, 7 ft. 9 in. high; if preferred, similar work to that shown in Fig. 3 can be used. For the bedstead bottom, iron fittings similar to those used for wood bedsteads are advised. Fig. 4 is a sketch of the iron angle, and B (Fig. 2) shows the position in which the angles are placed. They are securely fastened to the wood with screws, and the stretchers and laths are attached in the usual manner.

Removing Stain from Polished Wood.—A soda-water stain on polished wood should be wiped over with linseed oil as soon as noticed. If left unoiled, the only alternative is to repolish, first removing the damaged polish by rubbing with No. 1 glasspaper and oil. If this treatment is not a success, use spirit instead of oil.

Making Plumbago Crucible.—In making a crucible with a quantity of plumbago dust, mix the plumbago with an equal weight of fireclay, and add water while kneading to form a stiff dough. Keep this in a cool place for a few days, and work it from time to time, when it will become less sticky and more plastic; the clay should be almost too stiff to work by the hand when it is ready for moulding. For this, use an iron mould with a plug attached to a handle. The mould should be filled with the clay and the plug hammered in, to form the hollow of the crucible. It is kept in a warm place for a few days, when the crucible will leave the mould, and may be turned out. It is dried in a warm place for several weeks, and gradually heated when it is used for the first time.

Varnishing Photographic Negatives.—The retouching of a negative should always, if possible, be done before varnishing, such portions of the negative as are to be operated on being covered with a retouching medium. This medium may be purchased, or may be made of gum dammar 96 gr., turpentine 1 oz. If it is preferred to varnish before retouching, the varnished negative must be rubbed down with powdered resin to give a surface on which the retouching pencil can be used. The following varnish is recommended. Sandarach ½ oz., seed lac ¼ oz., castor oil 80 drops, oil of lavender 40 drops, alcohol 10 oz. Powder the resins and dissolve in the alcohol, and add the rest of the ingredients. Warm the negative till it is as hot as can be comfortably borne by the back of the hand, pour a pool of varnish in the centre of the plate, and let it flow first to the top right-hand corner, next to the top left-hand corner, then to bottom left-hand corner, almost touching the thumb, and pour off the excess at the bottom right-hand corner into the bottle. The negative should not be rocked. If the varnish is inclined to be streaky it is too thick, and more alcohol must be added. Conduct the whole operation as slowly as possible. Drain thoroughly, and bake the varnished negative in front of the fire or over a gas jet till the varnish is quite hard. Heat the negative evenly or it will crack. The negative should be held by the extreme corner with the thumb and forefinger of the left hand, unless it is larger than half plate.

Colouring Gold.—The simplest method of colouring gold jewellery is to bring it to a uniform heat, allow to cool (and thus become annealed), and then boil until bright in a pickle of 8 oz. of rain water and 1 oz. of sulphuric acid. Another method is to anneal the gold, boil it in a pickle of nitric acid and water, again anneal, and dip in the following colouring mixture. Two parts (by weight) of saltpetre and 1 part of table salt are heated in their dry state in a colouring pot or blacklead crucible; when hot, make into a paste with hot water, boil, add 1½ parts of muriatic acid, and stir well. Use at boiling point; leave the gold in the solution for not more than 90 seconds, as the solution removes more or less of the gold. On taking the gold from the colouring solution, rinse it in a pickle, dip it in hot water, and dry in hot sawdust: the gold will be spotted if not thoroughly dried. This method may be used with gold ranging between 12 and 20 carats fine, the best results being obtained with 15-carat gold.

The Preparation of Chromic Acid.—Chromic acid (H_2CrO_4) is produced by two or three methods. In one, 2 parts (by measure) of a cold saturated solution of bichromate of potassia are mixed with 3 parts of sulphuric acid; on cooling, the chromic acid is deposited in crystals, the mother liquor being then decanted. Perhaps the method of producing chromic acid more generally followed commercially is to decompose chromium sulphate with lime and to heat to redness the resultant paste of lime, gypsum, and chromium oxide. The chromate of lime formed is treated with sodium sulphate to yield soluble sodium chromate and gypsum. The addition of sulphuric acid liberates the chromic acid. A less wasteful process than this is the electrolytic one now being worked in Germany by Lucius & Brüning. In a solution of chromium sulphate in sulphuric acid are immersed both lead anode and lead cathode, chromic acid being liberated on the former and hydrogen on the latter. A current at 3·5 volts with a current density of 300 amperes per square metre is required, the cells being at the temperature of 50° C. (122° F.).

Making a Bone Apple-scoop.—In every sheep there are two bones specially suited for making apple-scoops, and with them only a small amount of trouble is left for the workman. The shank bones of Welsh or other mountain sheep are generally preferred for scoops; they make neater articles. But for larger scoops the shank bones of sheep of the larger breeds come in handy. To clean the bones, boil, say, for from half to three-quarters of an hour; too much boiling is liable to cause the head of the bone to slip off. With a tenon saw or a butcher's meat saw, on the flat side of the bone, as at A

FIG. 1

FIG. 2

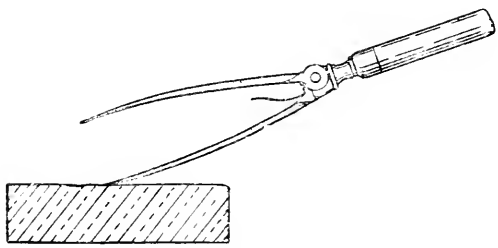
Making a Bone Apple-scoop.

(Fig. 1), make a shallow cut just deep enough to reach to the hollow containing the marrow. Next saw off the lower end of the bone, as at B. All the bone from the middle of the front between A and B has then to be chipped out. For this purpose, use a ¼-in. gouge, and afterwards a small chisel driven with a mallet; or a knife can be used, but then the work will take much longer. To cut the bone now left remaining to the shape of Fig. 2, use a half-round file. The two sides of the front and the circuit of the point must be brought to a sharp edge, as by these the apple is cut. Whilst the bone is being worked it will be sure to show more or less grease; this can be removed by a rag dipped in whiting, or by a crumpled-up piece of blotting paper. To extract the marrow from the hollow above A (Fig. 1), use a bit of crooked wire and a few small rolls of blotting paper. The opening should then be stopped with a neatly-fitting piece of cork, tucked in tightly. To finish, smooth the bone with glasspaper and polish with whiting.

Putting Sash Lines in Window Frames.—Before beginning to replace broken sash lines, carefully lower the top sash to see whether the breakage is at one or both of the lines. The ⅜-in. bead of the side at which the line is to be restored must be removed, a blunt chisel being used; a broad chisel bruises less than a narrow one. Begin the prising of the bead from the back, as, though the paint must be broken, it need not be defaced more than necessary. The lower sash can then be removed and the old line cleared with pincers or a blunt chisel. If the upper sash line is broken it is often best first to remove the line from the lower sash so that it may be put out of the way. The parting bead must next be removed, and pincers are better than a chisel for this. Sometimes a chisel, used to cut the paint at the lower half of the bead, is an advantage. Remove the pocket piece and take out the weight and old cord. If it is difficult to remove the weight, it is sometimes possible to tie a new line without removal. The new line is passed through the sash pulley by means of a "mouse," a piece of lead not thicker than the line and about 2 in. long, to which a fine strong twine is affixed; the twine is hitched to the sash line twice or thrice and the mouse is entered through the pulley, drawn through the pocket, and the line pulled through by its aid. If the weight is still in the sash frame, the line can be inserted in the weight by drawing through the mouse and making a knot. Lift the weight as high as possible and fix the line so that the sash will just reach the sill. Superfluous line is often a hindrance to proper working of windows, as the line always stretches in use. The replacing of the pocket piece can be done before the line is fixed to the sash, and, in the case of the lower sash, the parting bead can also be put in. The ⅜-in. or stop bead should be sprung in by getting nails nearest the ends in first. Sometimes they will need shortening, but no nails ought to be removed, and all should be guided to their holes, first those nearest the ends, and then those at the middle. If needful, a nail or panel pin may be inserted, but this is not necessary unless the bead springs away from its place. Care must be taken to strike on the old nails or the stopping will come out and the bead be made unsightly.

Condensation from Under Side of Iron Roof.—The dropping of water from the under side of a corrugated iron roof is caused by the moisture of the warm atmosphere of the room condensing on the colder surface of the iron roof, and this condensation, of course, goes on more rapidly during frosty weather. The remedy is to fix at the bottom of each sheet of iron a small half-round gutter to catch the water. Lead it to one end of the roof, and bring it to the ground by a down pipe. A lining of slag wool or silicate cotton supported by matchboard will prevent the condensation sometimes.

How to Set a Ruling Pen.—By taking out the screw of the ruling pen and looking directly at the point of the pen, it will be seen whether the worn point has a flattened surface. If so, place the pen on an oilstone (fine



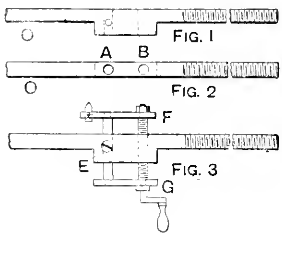
Method of Setting a Ruling Pen.

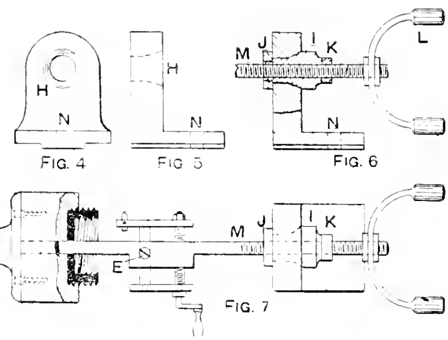
Turkey preferred) in the position shown in the sketch, apply a little oil, move the pen backwards and forwards, at the same time slightly rocking it horizontally and vertically. Wipe and examine the pen occasionally, and stop just short of bringing the point to a sharp edge. If one point of the pen has been injured and is shorter than the other, hold the pen upright on the stone and grind both points level before removing the screw and setting the pen. If the points are too sharp, the pen will cut the paper, and it will be necessary to take off the keen edge by using it for a few minutes on a piece of brown paper.

Making Photographic Printing-out Paper.—No one, unless he is likely to be a large consumer and able to afford a proper apparatus, should attempt to make P.O.P. The paper is sold so cheaply that it could only be made in large quantities at the same price; and expensive plant and long experience are necessary to ensure good results. Prepare two solutions. (A) Ammonium chloride 50 gr., Nelson's No. 1 gelatine 160 gr., Heinrich's hard gelatine 300 gr., distilled water 20 oz. (B) Silver nitrate 150 gr., distilled water ½ oz. Dissolve the gelatine in 1 oz. of water, warm and add the remainder; then add solution (B) a little at a time, stirring thoroughly between the additions. Allow the emulsion so formed to set, then wash by squeezing through mosquito netting, and washing or soaking in a few changes of distilled water. The shreds must then be well drained, melted down, and the emulsion is ready for use. The paper is unrolled over the surface of the emulsion, which is placed in a trough or a dish tilted to an angle.

Cutting Blinds.—Linen or art print blinds are cut upon a large flat table, using a long straightedge and marking awl. Equal width at top and bottom can be secured by folding the stuff so as to prick both at once; squaring must either be done by a large square working on a trued edge of board or by folding the blind (when made parallel) edge to edge and pricking through. Lines are made with a marking awl, and for cutting some use shears, others a knife and straightedge. Whenever possible, cut off the selvedges. Blind cloths vary in width; prints are made in every 6 in. from 30 in. to 60 in.; unions in almost every 2 in. in saleable widths.

Making Cells for Optical Work.—By following these instructions amateurs who have a small lathe not adapted for screw-cutting, and who are not adepts in the use of chasers, can make the brass cells and similar work for microscopes, telescopes, etc. The apparatus here described will turn and cut the threads without displacement, thus ensuring perfect centreing, without which the best lenses will give unsatisfactory results. To hold the cells, etc., use boxwood chucks fixed on iron face-plates. A hole is drilled truly in the centre of the chuck while in the lathe. Into this hole fits a turned iron or steel mandrel of the shape shown at Figs. 1 and 2. The part O should be a tight working fit in the boxwood chuck. The poppet end of the mandrel has a thread cut on it of a pitch suitable for optical work. Fig. 3 shows the complete mandrel and tool-rest. The hole B (Fig. 2) is tapped to receive the screw that regulates the cut of the tool, while into the hole A (Fig. 2) slides the guide; and the set-screw E (Fig. 3) takes up any shake in the rest. To complete the tool-rest, pieces F (Fig. 3) to carry the tool and G for the handle end will be required. The ordinary poppet must be discarded; in its place use a wrought- or cast-iron poppet, made as shown in Figs. 4, 5, and 6. The hole H (Figs. 4 and 5) receives the bush I (Fig. 6), which is drilled and tapped to suit the screwed end of the mandrel M. J and K are nuts, and L is a handle made fast to the mandrel; it actuates the cut of the tool longitudinally. N (Figs. 4, 5, and 6) is the hole used for bolting down the poppet. When facing, boring, or turning a cell, etc., the nut J is released and the nut K is





Making Cells for Optical Work.

jammed; then I can revolve, the cut being regulated by the handle L. When thread-cutting, the lathe spindle carrying the chuck must be fixed so that it will not turn; then the nut J is jammed tight, thus fixing I, the cut being actuated by the handle L. The thread may be started at any point desired. Fig. 7 shows the complete apparatus, with letter references as before. If the use of a lathe is not to be had, the apparatus will still be of use, but in that case all operations of turning and screw-cutting must be managed by the handle L, while the work remains at rest. The sketches are not to scale, and the apparatus must be made to suit the lathe in use.

The Manufacture of Glue.—Glue, size, and gelatine are varieties of the same substance; they differ only in the quantity of moisture and of impurities which they contain. Glue contains so many impurities that it is unsuited for use other than as an adhesive for wood, paper, etc. Gelatine-yielding substances are legion, those in commercial use including the skins of all animals, tendons, intestines, bladders, bones, hoofs, and horns. In the preparation of ordinary glue, great use is made of the parings and cuttings of hides from tan-yards; tanned leather is useless for the purpose. Briefly, the process consists in boiling the animal matter and straining the product into coolers, where it thickens into a jelly. This is cut into sheets of suitable thickness and dried in the open air on frames of wire netting. Spring and autumn are the most suitable times for drying the glue, the frost of winter and the dry heat of summer having injurious effects. The size is not dried, but is sold just as it is cut from the coolers. In making size and glue from shredded skins (chiefly those of rabbits), the processes in vogue at a large factory in America are as follow. 350 lb. of shredded skin and about 100 pailfuls of water are put into a wooden vat and boiled for two hours, the material being well stirred every fifteen or twenty minutes to prevent it settling. The liquid is then run off from the bottom of the vat and strained in a press which may be about 1 ft. square, 3 ft. high, and made of wooden slats. The interior of the press is lined with bagging, and through this material the liquid is strained or pressed by means of a hydraulic jack. The hot strained liquid drops into a vat below, whence it is conducted by means of hose into barrels. In from eight to ten hours the stuff is cool, and has a skin formed on the top; in warm weather ice is laid on this skin to harden it; this is size. For making glue, the strained liquid is run into coolers, these being wooden troughs lined with zinc, and in twelve hours' time the material, then in the form of jelly, is loosened from the trough by running a wire along it, the wire being bent to conform with the rectangular section of the trough. The block of jelly is cut up into cakes, and these are then sliced in an arrangement of fine wires stretched tightly across an iron frame about ½ in. apart; this frame is drawn through the jelly. The drying frames upon which the slices of jelly are then placed are about 5 ft. 6 in. long and 2 ft. wide, and are made of galvanised wire netting. The frames, when full, are placed in racks through which the air can circulate freely. It takes but a few days for the jelly to dry in a cool west wind, though a system of artificial drying, by means of which the size becomes glue in but a few hours, is now being practised. In drying, the material shrinks to one-half its former bulk. The hard glue is now washed to remove dust, etc., and to produce a glazed appearance. In some factories the cakes of glue are cut up into small pieces by means of two rotary knives, each making 300 revolutions per minute. First the glue is passed between two 1-in. toothed rollers which hold it in position and draw it forward after each stroke of the knife. In England the raw material, before being boiled, is limed; this treatment is not necessary in the case of hide cuttings from leather dressers and tanners, scrap from trotter-boilers, dry glue pieces and parchment cuttings, which are already limed. The liming is effected by soaking the material in milk of lime contained in pits. Afterwards it is necessary to remove or kill the lime by washing with water in vats or pits or even in revolving drums. The lime in old glue pieces is killed sufficiently by the action of the atmospheric carbonic acid, the glue being spread out in trays so as to be more readily affected. In some works the washed materials are subjected to heavy pressure, but in others the boiling is proceeded with at once. The boilers or pans generally have each a capacity of several tons. A false bottom of bars keeps a clear space at the bottom. In the middle of the boiler is a removable vertical framework, and its object, like that of the false bottom, is partly to give free space, so that the boiling liquid can circulate thoroughly, and partly to simplify the straining of the liquid. The pans are heated by a fire beneath, by steam, or by the two together. In placing the materials in the pans, any horn "sloughs" that may be used are built up around the central framework, the rest of the material being then put in. During the boiling intermittent stirring is necessary, and the fat which rises to the surface has to be skimmed off. The charge for the pans is in the proportion of twelve tons of fleshings to one ton of water. On the completion of the boiling, the fire is put out or the heat is otherwise removed; a time is allowed for partial settling and cooling, and the liquid is then drawn off through a wooden channel from the space beneath the false bottom. In this wooden channel are lumps of alum, and the liquid glue is conducted to cooling troughs, where it is allowed to cool and harden into a jelly or size. The succeeding processes by which the size becomes glue resemble those practised in America and previously noted. The methods outlined above admit of endless variations, nearly every manufacturer adopting a system that in some particular differs from that adopted by his fellows.

Soldering Gun Barrels.—Cramps are generally used for holding gun barrels together during soldering, although they can be bound together as a makeshift with stout binding wire. The heat is applied with iron or copper heaters, which are placed inside the barrels. The best flux for the purpose is sal-ammoniac. Baker's preparation can also be used as a soldering fluid.

Fixing Needle to Compass Card. Large compass cards often have two needles, in which case the agate cap is fixed in the card. In small cards the agate cap is fixed in the centre of the needle. Draw a pencil line on the under side of the card from N to S. points. Fix the needle to this with sealing wax or glue, and screw or rivet through the card.

Cabinet for Beadwork.—The cabinet or workbox here described is suitable for holding beadwork articles. It can be made of deal, and almost enough wood can be obtained from an old cube-sugar box; this, when sandpapered, stained, and varnished, will repay the time and labour expended. The following pieces will be required for the top case A (Figs. 1, 2, and 3). Two, $11\frac{1}{2}$ in. by 7 in. by $\frac{1}{2}$ in., for the top and bottom; two, 10 in. by 7 in. by $\frac{1}{2}$ in., for the sides; two, $10\frac{1}{2}$ in. by $6\frac{1}{2}$ in. by $\frac{1}{2}$ in., for the shelves; one, 10 in. by $6\frac{1}{2}$ in. by $\frac{1}{2}$ in., for the vertical partition; six, 5 in. by 3 in. by $\frac{1}{2}$ in., for the fronts of the drawers; twelve, $6\frac{1}{4}$ in. by 3 in. by $\frac{1}{4}$ in., for the sides of the drawers; six, $1\frac{1}{2}$ in. by 3 in. by $\frac{1}{4}$ in., for the backs of the drawers. The bottom for the drawers should be cut to fit the inside of the framework. The racks B (Figs. 1, 2, and 3) are 7 in. by 1 in. by $\frac{1}{2}$ in., and should have three holes bored in them to hold the tools. To make the desk C (Fig. 3), use two pieces of wood, each 15 in. by 4 in. by $\frac{1}{2}$ in., for the sides; one piece, $8\frac{1}{2}$ in. by $10\frac{1}{2}$ in. by $\frac{1}{2}$ in., for the top; one, $10\frac{1}{2}$ in. by 15 in. by $\frac{1}{2}$ in., for the bottom; one, $10\frac{1}{2}$ in. by 14 in. by $\frac{1}{2}$ in., for the back; one, $10\frac{1}{2}$ in. by 3 in. by $\frac{1}{2}$ in., for the front of the drawer; two pieces, $14\frac{1}{4}$ in. by 3 in. by $\frac{1}{4}$ in., for the sides of the drawer; and one piece, 10 in. by 3 in. by $\frac{1}{4}$ in., for the back of the drawer. To make the case, nail the top and bottom to the sides of the case A (Fig. 1). The partition and shelves are notched so that they will fit in flush with one another. The partition should be nailed to the top and bottom of the case, as should the shelves to the sides. The last are nailed to the top and bottom, and the case A is fastened to C by nails or (preferably) screws. The back, when fastened in, holds the top and bottom together. In C six holes should be cut to hold the saucers; these should be $\frac{1}{4}$ in. deep and 1 in. in diameter. The fronts of the drawers are rebated so that the sides will fit into them. After making the drawers, bore a hole in the centre of each of the fronts and glue a knob in to serve as a handle. The bottom drawer should have a partition in the centre, so that there will be a drawer for the finished articles; the other part can be used for the wire, etc. It would be advisable to label each drawer with the name of the beads it is intended to hold. The labels can be of paper glued on, or of tin nailed on; or if the necessary skill be possessed an attempt may be made at painting the name on the front of each drawer, the black letters being on a rectangular background of white. If glue also is used it will make the case look much stronger.

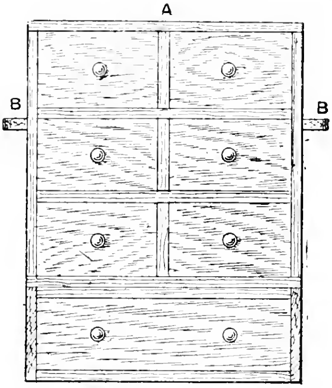


FIG. 1

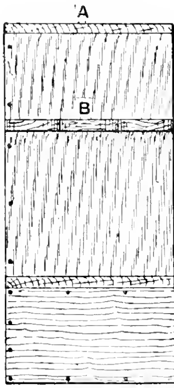


FIG. 2

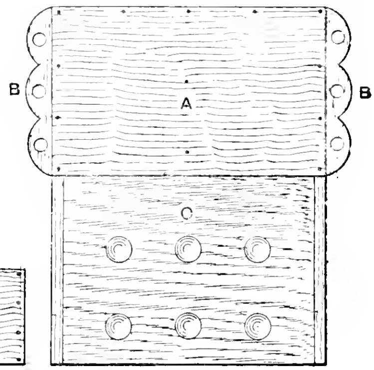


FIG. 3

Cabinet for Beadwork.

The Preparation of Crocus.—Crocus is an abrasive material used as a polishing medium for many metals. By one method of preparing it, a mixture of salt and sulphate of iron is put into a shallow crucible and exposed to a red heat; vapour escapes, and the mass fuses. When vapour ceases to be given off remove the crucible and allow it to cool. If the heat is too intense the oxide of iron produced will have a black colour. The mass, when cold, is pulverised and washed to separate the sulphate of soda. The crocus powder is then to be submitted to a process of careful elutriation, and the finer particles reserved for the final stages of polishing processes. A somewhat similar method of preparing crocus is to heat sulphate of iron alone in an iron pan; constantly stir with an iron spatula after fusion until it is thoroughly dry and drops into a pale yellow powder. This is then powdered in a mortar and sifted, placed in a fresh crucible, and calcined. On cooling, the crocus appears as a red powder. The colour of the crocus varies from pale red to brownish red, blue, and violet, the colour being determined by the particular degree of heat to which it was raised during its manufacture; the greater the heat the darker in colour and harder is the material; thus a pale red (rouge) is used for gold and silver, while violet, known as "steel red," is employed for polishing steel. To obtain the best results with crocus, it should be ground as fine as possible, and then washed with water. Three clean glasses are used for the latter purpose, one being filled with water; a quantity of crocus is well stirred in with a wooden stick, left to stand for about thirty seconds, and the fluid is then carefully decanted into the second glass, leaving a sediment at the bottom of the first; after two minutes in the second glass the fluid is decanted into the third, where it is left for several hours to permit the complete settling of the powder. The sediment contained in the first glass is too coarse to be of use; that in the second is a crocus of a finer quality; while that in the third is of the best grade. Crocus of varying degrees of fineness may be obtained on this principle. The material requires to dry slowly to be fit for use. It is advisable to moisten the dried powder with alcohol, and then to ignite it so that all traces of fat may be burnt. For this purpose the crocus should be contained in an iron pan. An excellent crocus powder for applying to razor strops can be made by igniting in a crucible a mixture of equal parts of well-dried green vitriol and common salt. Take care that the material does not boil over in a pasty state and be lost. When well made, out of contact with the air, it has the lustre of freshly cut blacklead. After grinding, elutriating, and drying, a powder is produced that, by applying to a smooth buff-leather strap, may form a serviceable razor strop, or by being mixed with hog's lard or tallow may make a useful polishing paste for many kinds of metal.

Brush Marks in Enamelling.—In using air-drying enamels on cycles great difficulty is sometimes experienced in getting a surface that is entirely free from brush marks. Assuming that the enamels are not stoved, the trouble may be due to one of the following causes. First, the brush may be too stiff; use a very soft brush with a big head and long hair. Secondly, the enamel may not be sufficiently thinned; add a little turpentine, when the coat of enamel will be thinner and more uniform, but not so lustrous. Thirdly, the enamel may dry too quickly; this is often the case with enamel paints, many of them showing signs of drying immediately after they are laid on, and such enamels show brush marks very strongly.

Repairing Mackintosh.—If the water penetrates the mackintosh in a few places only, obtain from a rubber warehouse some rubber cloth in the piece as near like the coat as possible; also get some rubber solution. Cut the rubber into circles large enough to cover the leaks, spread the rubber solution upon them, and also upon the mackintosh inside wherever a leak occurs, and press the circles of rubber into place. Press under a weight for a day or two. The mackintosh should be thoroughly dry before being treated.

Boots Cracking Across the Toes.—All boots, and more especially ill-fitting boots, have a tendency to crease and crack across the toes, and to counteract this tendency the following precautions should be observed. Patent leather boots should always be rubbed down across the joint over the toes while the foot is slightly bent, the rubbing being done with the hand or with a piece of soft rag. If the weather is at all cold, the boots should be warmed in front of the fire before they are put on, and then rubbed. Calf leather boots should always be carefully treed up when cleaning them, and each time the boots are worn the creases should be taken out by rubbing with a bone.

Moulds for Casting Brass.—In making moulds for fine brasswork, ordinary sand should be mixed with loam, which is a more clayey sand. The mould must be well dried before a fire, and then dusted with very fine charcoal powder. If a very delicate surface is desired, it could be smoked over with a pitch torch. This method is more troublesome, but the results are excellent. The patterns must be inserted after the smoking, and the two faces brought together again. The soot from the smoking will give a perfectly smooth surface, and the castings will come out clear and sharp.

Testing a Try-square.—Below is given a method of testing a carpenter's square. Shoot the edge of a piece of board quite straight, apply the square as shown at A (Fig. 1), and draw a line; then turn the square as at B, and if it is true the blade should fit the line; if it is less than a right angle it will be as shown at C D (Fig. 2), and if more than a right angle the defect will be as indicated at E F (Fig. 2). If the blade has moved or has been knocked out of truth through a fall, it should be knocked back into its proper position and, when true, the rivets should be tightened by careful hammering. If the blade is quite fast in the stock, but untrue, it must be filed true to the stock.

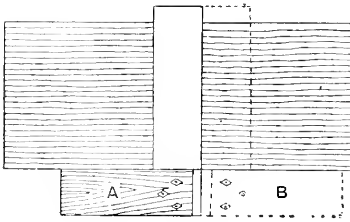


FIG. 1

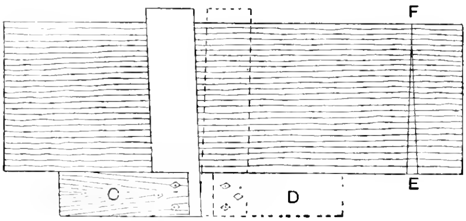


FIG. 2

Testing a Try-square.

Prevention of Nodules on Electrotypes.—Warty nodules on the edges of electrotypes are usually caused by the employment of small currents. This may happen by using a small cell or small elements in the cell, or by the employment of connecting wires having a high resistance. It is unusual to find these nodules on edges protected with paraffin, and their existence points to a soiling of the parts whilst blackleading the mould. When these nodules are troublesome, it is usual to take out the moulds, cut or file off the warts, give the copper a dip in nitric acid to clean it, then re-immerse the electrotype, and proceed with the deposition.

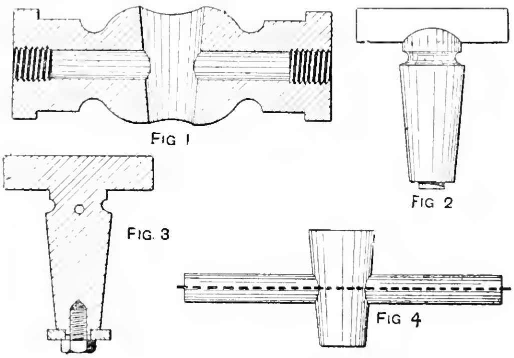
Coloured Varnishes for Straw Hats.—All straw hat varnishes are required to dry in a few minutes and form a firm, pliant, and elastic cover, though a high lustre is not essential. Hence spirit varnish is particularly suitable; any desired colour is gained by the addition of pigments soluble in alcohol, the coal tar (aniline) colours being best adapted for this purpose. Generally, the manufacturer of straw hat varnish prepares two or three colourless stock varnishes which may be coloured as occasion requires. Shellac is the indispensable gum for every spirit varnish, but it cannot, owing to its brown colour, furnish a white or pale varnish, so it is suitable only for dark coloured varnish. A good stock varnish from which black, brown, dark green, deep blue, and similar tones may be made is obtained from 180 grammes of shellac, 45 grammes of soft Manila copal, 45 grammes of sandarach or resin, 1 gramme of castor oil, and sufficient methylic alcohol to form a suitable solution. To produce coloured varnishes from this the respective alcohol soluble aniline colour alone need be added. Ivory black, spirit blue, Bismarck brown, aniline yellow, brilliant green, safranine, and crystal scarlet are among the colours suitable for this purpose, and by their mixture the most varying tints can be produced. The purest and best of these colours should be used; then only a little colour will be necessary. Straw hat varnish making is throughout a cold process, only careful intermixing, slow digestion to complete the solution, stirring from time to time, and perhaps filtration, being necessary. To the above stock varnish add, to obtain black, 55 grammes of spirit-soluble ivory black per 9 litres of varnish; the shade may be varied beautifully by a slight addition of spirit blue or malachite green. For olive brown, add 15 grammes of brilliant green, 55 grammes of Bismarck brown, and 8 grammes of spirit blue. For olive green, add 28 grammes of brilliant green and 28 grammes of Bismarck brown. For nut brown, add 55 grammes of Bismarck brown and 15 grammes of nicrosine. For mahogany brown, add 28 grammes of Bismarck brown; the colour may be deepened by a little nicrosine. For peacock blue, add 55 grammes of spirit blue and 28 grammes of induline. The above are mostly dark coloured varnishes, for the preparation of which shellac is only suitable. Some lighter coloured solutions will now be given. A white stock varnish suitable for the preparation of light-coloured straw hat varnish is a solution of 27 grammes of sandarach, 9 grammes of elemi-resin, 9 grammes of pine resin, and $2\frac{1}{2}$ grammes of castor oil in 18 centilitres of methylic alcohol. To produce a golden yellow colour, add to 9 litres of this varnish 55 grammes of chrysoidine and 55 grammes of aniline yellow. For pale green, add 55 grammes of brilliant green and 7 grammes of aniline yellow. For medium blue, add 55 grammes of spirit blue. For deep blue, add 55 grammes of spirit blue and 55 grammes of induline. Vary the proportions of these two pigments to obtain other blue tones. For peacock blue, add 5·5 grammes of spirit blue, 28 grammes of induline, and a little brilliant green. For violet, add 28 grammes of methyl violet. For crimson, add 55 grammes of safranine. For chestnut brown, add 55 grammes of safranine and 15 grammes of induline.

Melting Silver in an Open Fire.—Procure a small fireclay crucible in which to melt the silver. For a flux use equal quantities of finely powdered charcoal and sal-ammoniac. Make up a large, bright coal fire in an open grate, and when the fire is quite clear break a hollow space in the centre. In this space place the crucible, and allow it to get red hot; then put in the silver, and draw some of the hot coals closely around and over it. Blow the fire with the bellows until the crucible gets white hot, when the silver will melt, the fusing point being at 1873° F. (1022·7° C.). Then add the flux to clear the surface from scum. Again make the crucible hot, and quickly pour the contents into an iron ingot mould previously made scalding hot. One or two ounces of silver may be melted at a time in this way. The flux may be stirred with a pointed rod of iron previously made red hot.

Particulars of Rectilinear Photographic Lens.—The word rectilinear simply means "right lines," and is a name applied to lenses which do not distort straight lines when such fall near the margins of the plate. Such lenses represent a square as a square, and not like a pin-cushion or a barrel, as is the case with a single lens when the stop is placed respectively behind or before the lens. Consequently, rectilinear lenses are doublets—that is, they have a lens at each end of a tube, with the stop between, thus introducing both kinds of distortion, the one nullifying the other.

Cleaning W.C. Basins.—To clean w.c. basins apply spirit of salts by means of a piece of old rag tied to the end of a stick, and after sufficient time has elapsed for the incrustation to become softened, or partially dissolved, wash with clean water. If the incrustation is very thick, the operation can be hastened by scraping. Any spare acid should be thrown down the drains, as it is a dangerous poison.

Making Brass Gas-cocks.—Here are given full instructions on casting and finishing small brass gas-cocks. The patterns may be of wood or brass, but brass is to be preferred, as it wears much better than wood. Core prints must be turned on the ends of the patterns so that, when moulded, places will be left in the mould in which to insert the core. The patterns must be made sufficiently large to allow for shrinkage and for the metal turned off in finishing. The ends of the core patterns must be exactly the same size as the core print on the brass pattern. Core stocks for each of the cores must be made. The keys may be made in the same manner as the body of the casting. Figs. 1 to 4 give views of the body of the cock and the key in two positions. The key must be sufficiently large to turn down for grinding. Make the moulds, trim them, and they will be ready for finishing. In finishing the cock, use an iron bell chuck or an ordinary brass-turner's chuck. Turn one end of the cock square, and thread the hole with a suitable sized thread. Repeat the operation at the other end of the cock. Skim the cock all over, and face both ends of the keyway. Then turn the hole for the key slightly taper as cast. Now skim the outside of the key casting on the taper similar to that of the hole in the cock, and press the cock on. If it does not go on as it should, skim a little more till it is correct. Square the end off, drill a hole up it, and thread with a screw to carry the small brass screw that holds on the D washer, to prevent the tap being pulled off and to obviate the



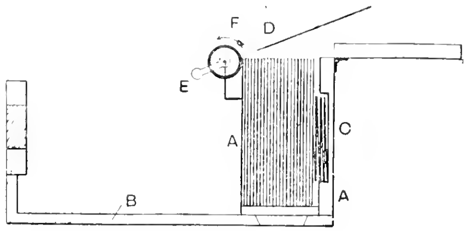
Making Brass Gas-cocks.

escape of gas. Each tap must be turned to each cock, and must be left in it till ground; this will save time and waste. In grinding in, fix the tap in the chuck, place a little loam and water on it, and press on the cock. This will cause the loam to grind down the surface of the key and make a good joint. The common test applied by the workman is to draw out all air by the tongue and mouth, when the cock will, if sound, adhere to the tongue. The key must have a round hole drilled through it, and at the top should be inserted a pin, which catches on the top of the cock and prevents its being turned more than halfway round. In making the sand core, insert a piece of thin iron wire through lengthwise; this will strengthen the core (see Fig. 4). The cores in each case must be made to suit the purpose, and will depend on the size and nature of the cock in hand.

Making Hand-cart for Carrying Furniture.—The cart here described is 6 ft. long by 4 ft. 6 in. wide, and may be used for carrying furniture. As the wheels are to run underneath the bed of the cart, the distance between the springs must be less than is customary in ordinary work. Set out a full-size plan of the cart, mark in the position of the wheels, so that the stock hoop does not project beyond the side of the cart, and mark in the position of the springs or stays to which the axle is fixed, as summers have to be framed in to fix these to. For the outside framing, two rails 2 in. wide by 1¼ in. deep, front and hind bars 2 in. wide by 2½ in. deep, are framed together square and true, and flush on top. This framing is boxed out on the top inner edge, ¾ in. on by ⅜ in. deep, to take the boards to form the floor. At such a distance in from the outside as the springs will come, frame in two summers 2¼ in. wide, thick enough to be level with the boxing out on top, and flush with the cross-bars at the bottom. If the cart is to have two handles, these are bolted to the summers; if there is to be only one handle, it is fixed in the centre underneath the bottom to both the hind and front bars. Next bolt on the springs or stays; if springs are used, see that the scroll irons and springs combined are of such a depth that the wheel is 3½ in. clear at the top to the under side of the frame; if iron stays are used, 1 in. clearance will suffice. Having bored on the springs and fixed the axle, put in the bottom boards of red deal ¾ in. thick, the grain of which should run from side to side. To protect the outer corners of the frame, iron corner-plates should be fixed round, about 6 in. each way. The wheels should be about 2 ft. 9 in. high; this would bring the top of the cart about 3 ft. 3 in. from the ground line. To make the cart more useful, portable boards may be fitted round by placing small iron staples on the outside of the frame, and irons on the boards, the irons being so made as to slip into the staples.

Why the Welsbach Mantle gives Light.—The temperature of the incandescent bodies with which a Welsbach mantle is impregnated may be assumed as being about 3500° F. The quality of the light depends to a certain extent on the amount of air admitted, which should be just sufficient to ensure combustion of the gas; the burners employed are constructed on this principle. The quality of the light in an incandescent burner depends on the raising of the finely divided rare earths (thoria, ceria, etc.) to the highest degree of incandescence by the agency of a Bunsen burner, which is constructed in such a manner that the amount of air and gas supplied to the burner are in the proportion which will yield a non-luminous flame and give out sufficient heat to effect the object required.

Stereoscope for Holding a Number of Views.—A simple effective stereoscope for exhibiting a large number of views is shown in the accompanying sketch. The apparatus consists of a box A with sliding adjustment along a wood strip B similar to the usual form



Stereoscope for Holding a Number of Views.

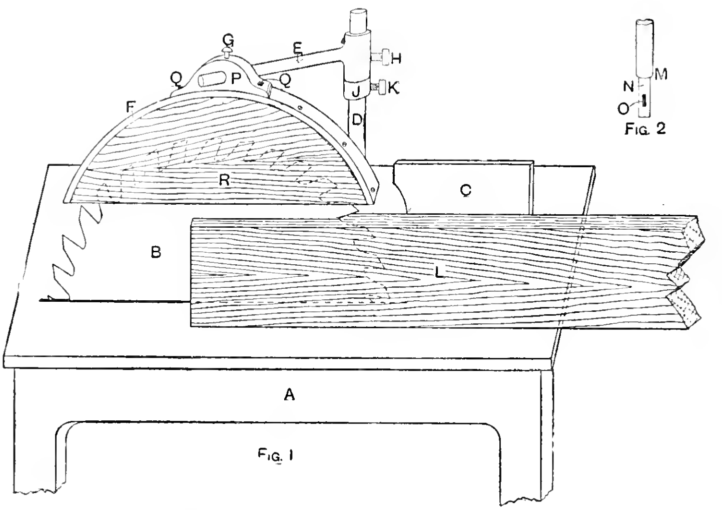
of cheap stereoscope. At the back of the box at C are two spiral springs which sink into a recess. By these springs the front picture is kept in position, whatever number of views the box may contain. Across the front of the box is a rod D worked by a handle E. With this rod turn two rubber-tyred wheels F, one on each side. To use the apparatus, the box is filled with pictures (which should be pasted on thin mounts), and the focus is adjusted for the front picture, which is removed as soon as it is done with by turning the handle in the direction indicated, when the wheels F drag the picture out of the way and it falls into the top. The next picture, pressed forward by the spring, is already in position. This apparatus might easily be constructed in pedestal form if the focal adjustment is effected by means of a long screw with a handle and a nut in the bottom of the box. The changing handle would, of course, be fixed outside by lengthening the rod D.

Depositing Nickel on Wax Moulds.—Before nickel can be deposited on a wax mould so as to get a smooth sheet it is necessary to prepare the mould with blacklead or with bronze powder as for the electrotype process, and first deposit on it a thin film of copper in an electrotype solution. If the object desired is a copy of a design impressed on the face of the mould, it will be advisable to remove the mould to the nickel vat when it has become coated with a very thin film of copper, and deposit the nickel on this film. If the design is not undercut, it may be possible to peel off the film of copper from the nickel; but some difficulty may be experienced in getting a deposit of nickel thick enough to form a plate or sheet, as thick deposits have a tendency to crack, curl up, and peel off. To get a tough coat, the nickel should be deposited slowly with a low-tension current.

Cutting the Top off a Stoneware Jar.—In cutting the top off a stoneware pickle jar, first make an ink mark right round the jar at the place where it is to be cut; then with a *new* triangular file wetted with turpentine make a mark over the ink mark, cutting through the glaze. Enlarge the file mark with a rasp, lubricating with turpentine. It is better to cut through the jar with the rasp, but as this process is very tedious, after cutting halfway through stand the jar in water up to the file mark, and with a chisel and hammer tap on the file mark until the top comes off.

Making Rubber Solution.—With a sharp knife wetted, cut into thin slices 1 oz. of pure Para rubber. Place it in a wide-mouthed bottle, cover it with carbon bisulphide or benzene (coal-tar naphtha), and cork down. Next day the rubber will have swollen considerably and have absorbed most of the liquid; pour on more liquid, and continue the addition until a thick fluid is obtained. One ounce of rubber will make about 1 pt. of solution, which is used as a cement for rubber goods.

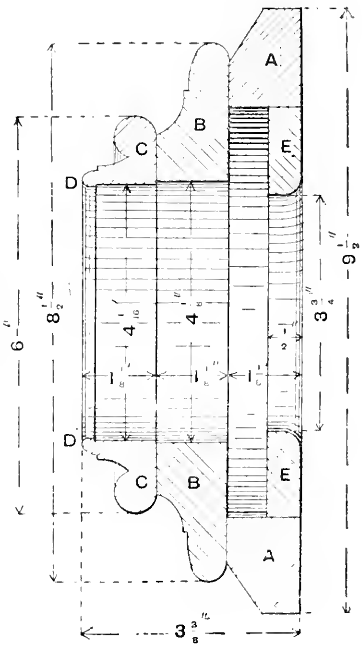
Making a Safety Guard for a Circular Saw.—The liability to accident by timber being thrown from the circular saw has necessitated the provision of safety guards. The guard about to be described is simple in construction, efficient, and comparatively inexpensive. Fig. 1 of the accompanying illustrations shows a saw bench with a suitable guard fixed in position; A is the bench, B the saw, C the fence, D a pillar, E radial arm, F the guard hung to the arm and secured by means of a small pin G. The radial arm is held in position by means of a set-screw H. By easing this screw the guard may be turned back out of the way while screws are being changed, or while a saw is being topped in the bench. Immediately underneath the socket of the radial arm there is a collar washer J, which is also held in place by means of a set-screw K. The advantage of this washer is that when the



Making a Safety Guard for a Circular Saw.

set-screw that secures the radial arm is eased, the washer prevents the socket of the arm from sliding down the pillar. If there were no washer, the left hand would have to be used for holding the arm so as to prevent it sliding down the pillar, when the guard would drop on to the saw. L indicates a piece of timber partly cut by the saw. It will be seen that the guard does not come down on to the piece that is being sawn. The sawyer is therefore able to see the tooth in the cut. This is an important point; for if nothing can be seen of the teeth or cut (as is the case with some guards), it is impossible for the sawyer to see whether the saw is making a true course or not. It will also be seen that this guard may be raised or lowered to suit timber of different depths. There should be two or three guards of different sizes for saws of various diameters. The same radial arm will answer for all the guards. The iron pillar D (Fig. 1, and illustrated by Fig. 2) should be of suitable length, and about 1½ in. in diameter. At M there is a shoulder that rests square on the top of the table. The part N is square, and there is a cotter-way O to receive a small cotter. Near the outer edge of the table a square hole is made by first boring a hole and then filing it square. The square part N of the pillar should fit nicely in this hole. A cotter is then driven in the cotter-way, which holds the pillar firmly in position. The square prevents the pillar from turning in any direction. The guard F (Fig. 1) is a piece of wrought iron about 1¾ in. wide by $\frac{3}{16}$ in. thick, and of suitable length, and drilled to receive the necessary screws and rivets, or small bolts with nuts (see Fig. 1). This piece of iron is bent to the required curve. A piece of iron is now made to the shape shown at P (Fig. 1), or any convenient shape. A hole is made at the centre to receive the radial arm E, and another hole drilled at the top down through the centre to receive a pin that passes down through it and the radial arm, thus securing the guard to the arm. Holes should also be drilled at the ends to secure the piece to the guard by means of small rivets or bolts, shown at Q (Fig. 1), passed through holes in the guard and riveted, or the nuts screwed up tightly, as the case may be. A piece of wood ½ in. or ⅜ in. thick is now shaped as shown at R (Fig. 1); the bent piece of iron or guard is screwed to this. This piece of wood not only protects the saw but also makes the guard more rigid. The guard is now completed, and when shifting guards, all that has to be done is to withdraw the pin G, place the other guard on the arm, and insert the pin lower, or raise the guard, as the case may be, to suit the diameter of saw or depth of piece that is being sawn.

Turned Wood Case for a Drum Clock.—The useful and ornamental clock case illustrated below is in three separate mouldings A, B, C, and is thus much easier to turn than if it were all in one piece. It can be made in satin walnut, mahogany, oak, etc., but the first is very easy to work, cheap, and, when polished, looks well. Start with the moulding marked A, the



Turned Wood Case for a Drum Clock.

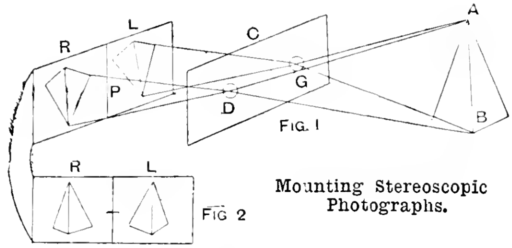
wood for which should be 1¾ in. thick. The back is first planed or turned flat, and the block is then placed on the screw chuck and the outside turned and finished with glasspaper. Then with pencil or compasses strike a circle 6½ in. in diameter and cut right through on the line with a thin parting tool; this inside piece will then be large enough for the top moulding C. The middle moulding B should be made in the same way. For the top moulding C turn and finish the outside, and bore to 3⅞ in. for the inside lip at D, $\frac{3}{16}$ in. long. Then place the moulding in a hollow chuck and bore it out to 4$\frac{1}{16}$ in. by $\frac{1}{16}$ in. deep. The sizes given are for the globe drum clocks, costing a shilling or so each. Of course, the inside measurements must be varied according to the size of clock to be fitted. The three mouldings are glued together, three screws 1½ in. long being put through A into B, and three through B into C. Unscrew the ring and legs from the clock, and drive soft wood pegs in place to keep the works from slipping. A ring E, which just overlaps the edge of the clock and fills the space, is not glued in but is held in position by three screws, so that the clock can be removed at any time if required for repairs, etc. A brass plate screwed on the back for hanging the clock completes the case.

Black Streaks in Nickel-plating.—Black streaks in deposits of nickel are caused by bubbles of hydrogen gas, which form in clusters on the surfaces of articles and then burst. They may be prevented by gently agitating the articles whilst being plated, or by stroking the clusters with a stout feather and thus bursting them.

They appear frequently when nickel solutions have not been agitated for some time, and have consequently settled in a stratified condition. It is therefore advisable to stir the solutions occasionally in the evenings, and thus thoroughly mix the contents.

Fitting a Watch Hairspring.—In applying a new hairspring to a watch, the centre coils are broken out, about a quarter of a turn at a time, until there is room for the collet. The effect of this upon the time of the watch can be neglected, as the actual length of spring removed is so small. Now bend a small length sharply inwards for pinning into the collet. Place the collet, right way up, on a broach, and push it on tightly; hold the broach in the left hand, pass the hairspring down the broach, and with the tweezers in the right hand, insert the end of the spring into the hole in the collet. Lay the broach down, with the collet and spring on, and file up a brass pin to fit. Then fix it in and break off the pin, which should previously be half cut through with a pocket-knife.

Mounting Stereoscopic Photographs.—It is sometimes the case when viewing mounted stereoscopic prints that the objects in the background, when seen through the stereoscope, appear in front of the picture. The cause of this may be gathered from a consideration of the following principles. Let A B (Fig. 1) represent a pyramid and C the lens-board of a camera, with lenses D and G forming inverted images R and L on the plate P. Supposing the operator to be standing behind the plate, the image formed by D at R will be similar to that seen by the right eye, and the image formed by G at L similar to that seen by the left eye. Now if a print be taken from this negative by placing a sheet of sensitive paper against the film it will be like



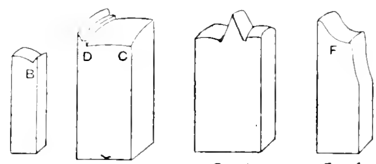
Mounting Stereoscopic Photographs.

Fig. 2—that is, the left-hand view as seen by the left eye will now be on the right, because the images have been turned the right way up. Practically, the reason why the distant objects come forward is that the right eye is looking at the left eye view, and *vice versâ*, owing to the two views not having been transposed in mounting. In mounting stereoscopic prints, to prevent confusion, lay them face down, and run a short line across the back of the paper where the two prints join (see Fig. 2). Trim straight across the two prints for the base line and for the top. Now cut the prints in half and trim to about $2\frac{3}{4}$ in. square, leaving on the right of the right-hand print $\frac{1}{4}$ in. more of the picture than appears on the left-hand print, and on the left of the left-hand print $\frac{1}{4}$ in. more of the picture than appears on the right-hand print. Now mount the prints about $\frac{1}{8}$ in. apart, with the half-lines on the outside of the print instead of being joined as they were before the print was cut.

Cubing Round Timber.—The easiest way of measuring round timber, to get the solid contents, is to take one-fourth of the middle girth of the timber in inches, square this dimension, multiply by the length in feet, and divide by 144; the result is the reputed cubic contents. If the bark is on, make an allowance for it by deducting 1 in. per foot from the actual girth before dividing by 4. Example: Round log of oak 20 ft. long, 18 in. diameter one end and 12 in. the other, girth 48 in. Then 48 in. = 4 ft., 1 in. per foot = 4 in., and 48 − 4 = 44 in.; quarter girth = 11 in., 11 squared = 11 × 11 = 121, and 121 × 20 = 2,420. Then $\frac{2,420}{144} = 16{\cdot}8$, say 17 cub. ft.

Copper-plating Model Boat.—Instructions are here given on copper-plating a boat made partly of metal and partly of wood. First well soak the woodwork of the boat in linseed oil to close all the pores and prevent the copper solution penetrating the wood; then expose it to the air for a day or two to oxidise and harden the oil. The part to be coppered must now be coated with blacklead, well brushed in and polished. On this coating the copper will be deposited, therefore the connecting wires must be in close contact with it at several points. Dissolve copper sulphate crystals in hot rain water until the water is saturated with copper, and will not dissolve any more. Allow this to get cold, then add 4 fluid ounces of sulphuric acid to each gallon of solution. Use anode plates of pure copper connected to the copper elements of the battery. Work the solution cold with current from two Daniell cells of $\frac{1}{2}$-gal. capacity. Connect the cells in series (copper of one to zinc of next) to start the deposit, and when the boat is covered with a thin film of copper connect the cells in parallel to finish.

Cutting Shoe Finishers' Irons.—Irons for ironing up the edges of boots and shoes are of various forms, a few of which are shown in the illustrations. They will serve as examples of how irons should be made and recut. The iron is of such importance to the finishing of all classes of work that it is worth while to learn how to cut kit, as it is called, especially by those who are at a distance from any large town. If new irons are to be made, stocks for them must be procured; these stocks are oblong pieces of squared iron, which are ultimately shaped as shown in Figs. 1, 2, 3, and 4, each iron having a stem at the bottom that can be driven into a handle. The better way, however, is to buy the irons already shaped, as they are very cheap, and then a careful recutting produces a good iron. Stocks for some of the smaller irons can be made from the butt or shank ends of files or rasps. A small vice and the necessary files are the tools required. Fig. 1, in which the crease or indentation B produces a bead on the edge of the sole, can be made like all irons of that kind, single and double, in sets in various sizes. The same remark applies to Fig. 2, but in the latter an indentation or crease is thrown upon the welt side. If these two irons are combined in one, the crease at Fig. 1 being placed at C in Fig. 2, a double iron is produced, and a set of such irons would be very useful. They can run up to almost any size, by widening the



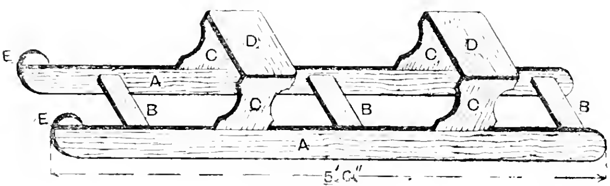
Shoe Finishers' Irons.

space between C and D (Fig. 2) from $\frac{1}{8}$ in. upwards, increasing the space by $\frac{1}{32}$ in. for each size. Fig. 3 is somewhat like Fig. 1, but with a slightly flatter top. It shows a double pump iron, which is made to fit two thicknesses of edges; it is, in fact, two irons in one, and being larger than one iron only, it retains heat for a longer time. In Fig. 4 the curve marked F can be modified as required; being a waist iron, it is used to set up edges of all kinds, some of which are thin and square, others round, and others of various angles. The files can be bought in sets; they are called kit files, and can be obtained probably at almost any leather grindery stores. These files consist of a four-cornered file, a flat four-sided bastard file, a tapered file, a knife-shaped file, a small rat-tail file, and a triangular file. Jewellers' files of various shapes may also be used, and they come in very handy for cutting different fancy shapes. The rough cutting can be done with coarse files, and the finishing of the shaping process with finer files, a last touch being given with fine kit files. When the proper shape has been obtained the creases can be cut, or the beads squared up with the tapered file, the knife-shaped file, and the small rat-tail file, and the square beads finished with the triangular file. So far, the iron has only been shaped up and roughly finished as far as files can do it; the final finishing and polishing are done with emery powder. Coarse, medium, and flour emery are mixed with oil, the paste being smeared on pieces of leather and the iron rubbed upon it; the coarse emery is followed by the medium and then by the flour emery, the finishing being done with dry flour emery. If the iron is for setting up a stout edge, several pieces of leather are nailed together, and the emery smeared on the topmost one. During the filing operations the greatest care must be taken not to wear away the creases and beads.

Fireproofing Theatre Scenery.—In 3 gal. of water dissolve 1 lb. of alum. With a stock brush thoroughly soak the stretched canvas curtains or other fabric, leaving no part unbrushed. When thoroughly dry, prime in for painting. Another solution consists of 10 per cent. sodium tungstate. Apply as above, and when dry prime in.

Ghost Illusion for Amateur Theatricals.—Paint on canvas a scene representing a room or library, and showing a bookcase. The part of the bookcase that would contain the shelves and books must be cut out of the canvas, the framework only being left, and this framework must be so painted as to have a solid, substantial appearance. The canvas that has been cut out must be replaced by a black net or gauze, and the shelves and books must be painted on the gauze, so that when lighted up from the front the bookcase will appear complete. Behind the gauze and close to it the movable cat cloth is hung. This is a piece of canvas dead black in colour, 12 in. larger all round than the cut-out portion of the bookcase. The ghost or vision stands behind the cat cloth. The light is now turned down in the scene so that the room is darkened, and at the same time a good light is turned on at the back, and is so arranged that it falls on the front of the figure either from the left- or from the right-hand side. While darkening the scene and turning up the lights behind the cat cloth must be pulled up or drawn on one side, and the ghost scene is complete. With judicious management this will answer for tableaux by adding accessories on a large or small scale as may be necessary.

A Simple Sledge.—The accompanying illustration shows a sledge for two persons; it can, however, be shortened to accommodate one person only. It is 5 ft. long, 1 ft. 5 in. wide, and 1 ft. 6½ in. deep, and should be made of red wood, being afterwards painted. The sides A are mortised to receive three rails B, which bind them together: the rails are 3 in. broad. The sides C of the seats are dowelled to the long rails or runners A, and the seats D are nailed down. To stiffen the seats and frame, iron bands should be inserted, one below each seat, each being long enough to allow a screw to be inserted in the runner. A half-round iron strap is carried along the under edge of the runner, and

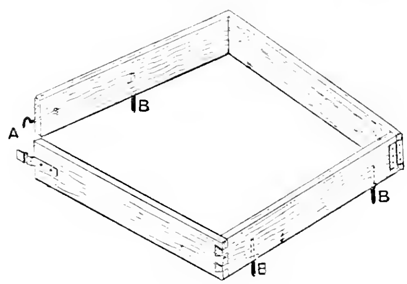


A Simple Sledge.

curled round in the front to form a loop, as at E, to which may be attached the hauling ropes. The following is the quantity of stuff required. Two pieces, 5 ft. by 4½ in. by ⅞ in.; three pieces, 1 ft. 5 in. by 3 in. by ⅞ in.; four pieces, 11 in. by 9 in. by ⅞ in.; and two pieces, 1 ft. 6½ in. by 10 in. by ⅝ in. The following are the positions of the rails and seats. From the nose of the sledge to the first rail is 6 in.; from the inside edge of this rail to the front of the seat is 7 in.; the centre rail is immediately in the centre of the sledge, and the second seat 7 in. from this rail; the back rail is 6 in. from the end.

Painting and Varnishing a Phaeton.—It is supposed that a phaeton is to be repainted black and picked out in red, and then varnished. If the paint is cracked very much, the best plan will be to remove it by means of a gas jet or burning lamp and an old plane-iron. The vehicle may then be filled up and painted. If the paint has only cracked through the varnish, rub it down to the colour with pumice stone and water, then clean off thoroughly and give a coat of colour made of tub white lead and a small portion of driers and lampblack, mixed stiff with raw linseed oil and thinned down with turps; this should dry in about ten hours, but should be allowed to stand a day longer to get hard. In the meantime the wheels, under carriage, etc., should be well rubbed down with glasspaper, and a coat of lead colour applied as above. Any holes or dents in the body should now be filled with a stopper made of dry white lead, gold size, and black japan, beaten up stiff with a mallet or hammer; and the wheels, carriage, and shafts puttied up where required, and afterwards lightly sandpapered off. The body, when the stopper is hard, is faced over very lightly with pumice stone and water to take out the brush marks in the lead colour, after which the whole is given a coat of ground drop black, thinned with turps and varnish; this should dry in about four hours. Then add a good drop of black japan to some of the dead black previously used, and give another coat; let this stand for a day, then give a good hard sponging off, ready for the first coat of japan. If the work is to be finished in a first-class manner, a second coat of japan is necessary; but before applying this the first coat must be flatted down with pumice dust and water on a pad of cloth to remove any nibs which may exist, and to make a dull surface for the next coat, as if two coats were put on without flatting the top coat would "ciss" up and spoil it. If only one coat of japan is given, the carriage, etc., will now be ready for lining out; for this, camel- or sable-hair pencils, called fine-liners, and picking-out pencils are used. The colour (vermilion) should be mixed in a small dipper with gold size or varnish to a creamy thickness. Another small pot contains clear turps. The pencil is dipped into the turps, then into the colour, and worked up on the palette; then, holding the pencil between the forefinger and thumb, and using the other fingers as guides, line out as required. When dry, well clean the whole with a sponge, and give the underworks and wheels a light coat of carriage varnish, and the body a coat of under-coating body varnish. After standing two days, well flat the whole as the japan was done, being careful to get out every particle of pumice dust from the corners and crevices, using water freely; then thoroughly dry off, and give the body a good full coat of finishing body varnish, and the under carriage, etc., a coat of pale carriage varnish, putting sufficient on to obtain a good finish without getting runs. To make a successful job, the carriage should be done in a light, roomy place, free from draughts, and kept at a temperature of about 75° F.

Stump Moulding.—The following supplements the information on stump moulding given on p. 36. Stump moulding is so called because the moulder works on a small bench called a "stump." The box parts used are about 18 in. square and 3 in. deep. The best are of mahogany or other hard wood to combine lightness and strength; they are hinged at one corner, and have a fastening at the opposite corner, as at A in the accompanying illustration. The hinges and fittings



Box for Stump Moulding.

may be of brass. The other two corners of the box are dovetailed together. The box parts are fitted together in pairs, the bottom part being made to take the pegs B. The moulder takes the bottom part, brings the ends A together, and secures them. He rams it up on a pattern plate or an oddside, and then rams the other box with the top part on the other side of the pattern plate or the other odd-ide. The two box parts are then put together and moved off the bench or stump to the floor. The corner A is unfastened, and the box parts are opened and removed, leaving the sand mould on the floor ready for pouring in the iron. It will be seen that only one pair of box parts will be required to make any quantity of moulds on this principle. Of course, this method is only suitable for use in casting comparatively small articles such as cast heel-tips for boots.

Colouring Gold.—The following pickle has been found very satisfactory for imparting a rich colour to gold rings, scarf-pins, etc. Alum (powdered) 1 oz., common salt 1 oz., saltpetre 2 oz., and water 10 oz. Wash the article to be coloured in warm water to which a few drops (say fifteen to twenty drops to a breakfast-cup full of water) of ammonia have been added, using a soft brush and soap. Rinse in cold water, and dry in hot sawdust. Then immerse the article in the pickle for about two minutes, and again dry in hot sawdust. Finally polish with rouge.

Hints on the Use of a Kodak.—The ordinary pocket kodak takes pictures 2 in. by 1½ in., and the folding and newer kodak takes pictures 3¼ in. by 2¼ in. When closed, the folding kodak measures only 1⅝ in. in thickness. These cameras, having a fixed focus (that is, allowing of no adjustment of the focus for near objects at different distances), are unsuitable for any but fairly distant views, where the variation in focus is very considerably less than with near objects at varying distances, because everything beyond a certain distance is more or less in focus. This result is obtained with a short focus lens and a small stop, but as the latter means long exposure, and as short ones are essential to good hand camera work, the fixed focus patterns cannot altogether be recommended.

Portable Dog-kennel.—One-inch grooved and tongued boards 6 in. wide is a suitable material of which to make the portable dog-kennel illustrated by Fig. 1. The boards of the sides should be nailed to a $1\frac{1}{2}$-in. by 2-in. ledge at the top and a 3-in. by $1\frac{1}{2}$-in. ledge at the bottom (see K and L, Fig. 2). The boards of the front and back should be nailed to similar ledges, as shown at E and F (Fig. 1). The boards forming each side of the roof should be nailed to the three bearers M, N, and O (Fig. 2). Fig. 3 shows the construction of the floor. It will be seen that the kennel will be composed of seven main pieces. A fillet about $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. should be nailed to each end of the sides, as shown in the longitudinal section (Fig. 2), and also by the enlarged section (Fig. 4); this is taken through A (Fig. 1). B (Fig. 4)

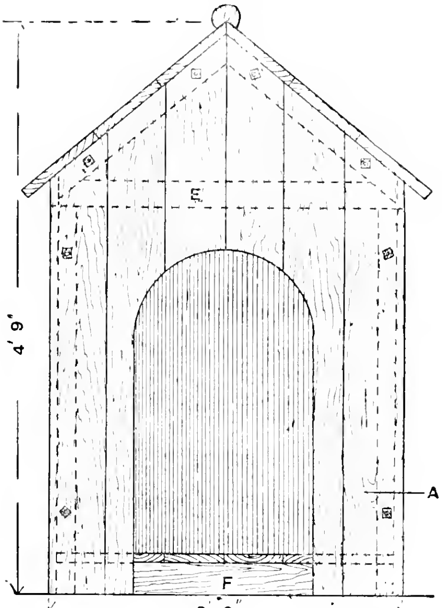


Fig. 1

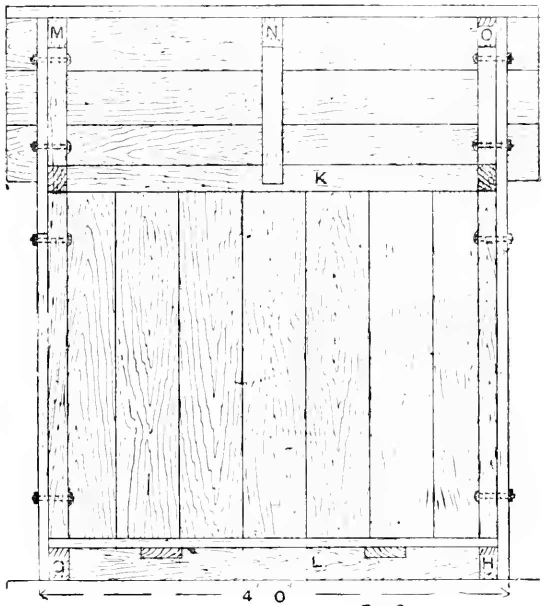


Fig. 2

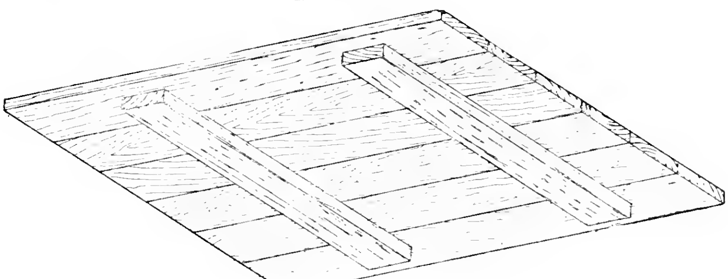


Fig. 3

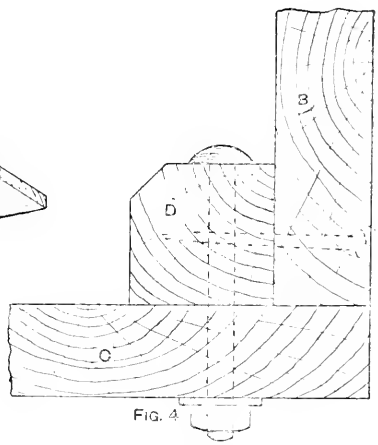


Fig. 4

Portable Dog-kennel.

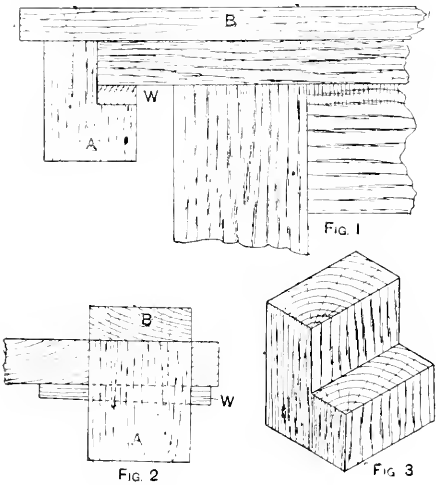
shows a portion of the boarding of the side with the angle fillet D nailed to it. The front and back can be fixed to the sides by eight $2\frac{1}{4}$-in. by $\frac{3}{8}$-in. bolts and nuts, as shown at Figs. 1 and 2, and indicated by the section, Fig. 4. Each half of the roof can be fixed to the ends by eight bolts and nuts in a similar manner. The floor will rest on the ledges G and H (Fig. 2) round the bottom of the boarding. The roof should be covered with felt.

Blackening Brass.—One method of blackening brass is as follows. Dip the article in a bath consisting of 1 part of sulphate of iron and 1 part of white arsenic dissolved in 12 parts of hydrochloric acid. When the article has become sufficiently black, rinse it well in several changes of cold water to remove the acid, dry in sawdust, and polish with blacklead; it may then be lacquered with a pale lacquer. Another method, and one more generally adopted, although somewhat more expensive, is as follows. Well polish the article with tripoli, and afterwards wash it well in a mixture consisting of 1 part of nitrate of tin and 2 parts of chloride of gold dissolved in a little water and acid. Remove the article and wipe it with a clean linen rag. A slight excess of acid will increase the intensity of the black. The following method will also be found very good, and is the same as that adopted in oxidising silver articles. Give the article a light silver-plating by deposition, in a similar manner to ordinary cheap electro-plated goods. Then prepare a solution made as follows. Dissolve in a little acetic acid 2 dwt. of sulphate of copper, 1 dwt. of nitrate of potash, and 2 dwt. of muriate of ammonia. After warming the articles, apply the solution with a camel-hair pencil or immerse in the bath, then expose them to the fumes of sulphur in a closed box. This may readily be done by placing in a tin biscuit-box a red hot iron bowl, such as the bowl off a small lead ladle, in which are a few pieces of sulphur. Hang the articles on a rod across the tin, and close the lid. It will be necessary to do this where there is a fairly good draught to carry off the sulphur fumes.

Tempering Gun Springs.—In tempering springs for guns and revolvers, make the springs red hot (be careful not to overheat them), then plunge them into cold water. Take them out, warm them over the fire, rub with suet, blaze them over a clear forge fire, and let them cool. The foregoing operation requires considerable practice to produce a desirable temper.

Making Pipe-eye Scroll-irons.—Coachsmiths' barrel heads of scroll-irons, or pipe-eye scroll-irons, are usually made as follows. For an ordinary sized one having an oval stem, take a piece of square edge iron 1 in. by ½ in. and well upset one end, making it rather wider than it is thick, setting it in slightly about 1½ in. from the end to help in forming the eye, and round it off a little. Then make hot a piece of flat iron 1¼ in. by ⅜ in. or ½ in. thick, according to the width of pipe-eye required, and with the top and bottom fullers set it in to make a round boss; nearly cut it through at the narrow part with the gouge, and weld it on one side of the iron already upset. Make another boss, and repeat the weld for the other side, at the same time working the pipe-eye to shape and size, and working up the oval close to the eye with the fuller so as not to cut in, afterwards using top and bottom oval tools. When the eye is something like the desired shape, punch a small ⅜-in. hole through the centre, gradually making the hole the required size with a steel mandril and working up the round eye in top and bottom tools.

Detachable Lath for Table Top. — The drawings herewith show a simple and effective arrangement for holding a lath to a table top. A cleat A (Figs. 1 and 2) is fixed to the end of the lath B by a couple of screws, as indicated, the cleat and lath being held to the table top by inserting a wedge W, as shown. Fig. 3 is a view



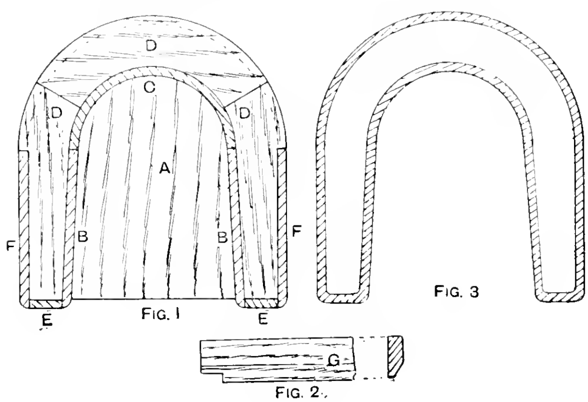
Lath attached to Table Top.

of the cleat; this and the wedge should be made of hardwood.

Calculating Weight, etc., of Copper and Iron Wires. — In calculating the sectional areas of wires, the diameter in inches corresponding to the number of the gauge of the wire must first be determined, and this can be got only from tables. Then to find the area of cross-section in square inches, square the diameter in inches (that is, multiply it by itself), and multiply by ·7854. To find the weight in pounds of a single wire, multiply the cross-section, determined as just described, by the length in inches and by ·28 for iron or by ·31 for copper. To determine approximately the weight in pounds of a stranded cable, multiply the weight of the length of single wire by the number of wires in the strand.

Timing of Watch Hairsprings.—The vibrations of a watch balance occupy exactly equal times (with an average hairspring) only when they are exactly equal in extent. For instance, in a watch with an ordinary flat hairspring, the balance vibrating exactly one whole turn, and going to time lying down, if the power be increased so as to make the vibrations of the balance one and a quarter turns, the watch will no longer be quite on time, but will either lose or gain—probably the latter. In such a case it may be said that the short arcs (one turn) are slower than the long arcs (one and a quarter turns). But in the case of a breguet hair-spring (with an overcoil), the spring can be so manipulated as to render the long and short arcs of the balance isochronous—that is, performed in equal times. In such a watch it would not matter whether the balance vibrated one turn or one and a half turns; the time registered would be the same. The average good three-quarter-plate English lever watch, when lying down, has a balance arc of about one and a quarter to one and a half turns, and makes what are termed "long arcs." When hanging up it will make about a quarter of a turn less, say one turn to one and a quarter turns, on account of the greater friction at the balance pivots when in that position. The balance then rests upon the sides of the two pivots instead of resting on the end of one, as in lying down. The watch then makes "short arcs." Obviously, if the short arcs are slow, the watch will go slower when worn in the pocket than when lying on the dressing table at night. But if the hairspring is isochronous, causing the long and short arcs to be performed in equal times, there would be no difference in the timekeeping, whether the watch was worn in the pocket or was kept lying down. Ordinary watches with hairsprings that have not been thus manipulated will lose about one minute per day in the pocket more than when lying down, the short arcs being then known as "sixty seconds slow." To test a watch for this error, set it on time by a regulator, noting its rate lying dial up for twenty-four hours. Then place it nine o'clock up for twelve hours and three o'clock up for twelve hours, and the sum of these two last positions will be its rate for the short arcs, while the first twenty-four hours' run will give its rate for the long arcs.

Pattern for Saddle-shaped Boiler.—A pattern for a saddle-shaped cast-iron boiler made as follows will answer for moulding in green sand. Prepare two substantial blocks A (Fig. 1) made to the inner contour of the casting. To these blocks nail or screw two pieces B and a piece C, all the pieces being made



Pattern for Saddle-shaped Boiler.

to the thickness of the metal; C should be saw-kerfed, so that it will bend to the required curve. On each end of B and C fasten D, and two strips E, running the whole length of the pattern. Finally attach F by screws, which may be released to facilitate removal of the core, which is rammed inside the pattern. The pieces F should be stiffened by removable battens to prevent the ramming bulging the pieces outward. The open part of the core is strickled to shape by a straight strip of wood G (Fig. 2) shouldered down to the thickness of the metal, and guided by and working between the two segments D (Fig. 1). When the mould is to be rammed, the battens used for stiffening the pieces F (Fig. 1) are removed. The inside of the pattern is then filled with sand and strickled off level with the convex edges of the segments. The latter is done with the flush edge of the strickle G (Fig. 2). After withdrawing the pattern, the stiffening blocks A (Fig. 1) are stopped off by filling up the spaces left by them in the sand. The core must be supported in the mould by studs or chaplets, and provision must be made for securing the vent of the core through branches or openings on the casting. Any branch on the casting not occurring at the junction of the straight and curved parts of the metal should be left loose, so that it may be taken away on a draw-back plate. Shallow bosses or facings should also be loose. All external edges of the casting should be well rounded. Fig. 3 shows the finished pattern.

Coloured Cement Floor. — In making a coloured cement floor 2 parts of Portland cement by measure are mixed with 3 parts of sand. Before adding the water, mix with it a little red oxide of iron. The exact quantity of oxide to use will depend on the depth of colour required, and must be found by experiment.

Particulars of Canada Balsam.—Canada balsam is a sticky, yellowish-white material, with an odour somewhat resembling turpentine. It is a crude turpentine, obtained by puncturing pine trees (Pinus canariensis), and is similar to the other forms of crude turpentine obtained from Pinus sylvestris and Pinus maritima. On heating it, the volatile portion passes off, leaving a hard resin which is used as a waterproof cement for glass, etc., and for mounting specimens for the microscope; for the latter purpose it is dissolved in chloroform.

Brush for Enamel Paint.—A hog's-hair lather brush for which a barber has no further use is best for applying enamel paint. Having been constantly in hot water, the bristles are split fine so that no hair marks will be left when applying the enamel. Neither mops nor fitches are of any use for the purpose; the latter are employed in general painting for touching up, filling in, cutting in, and lining. A fitch can be softened in hot water.

Setting-out the Bevel of a Hip Rafter.—Below is given a method of finding backing to hips. Set out to scale the line of the pitch of the roof as shown at A B C (Fig. 1), and a portion of the plan D E F G; E G will be the plan of the hip. At right angles to E G set up G H, making it the same length as the height B C, then

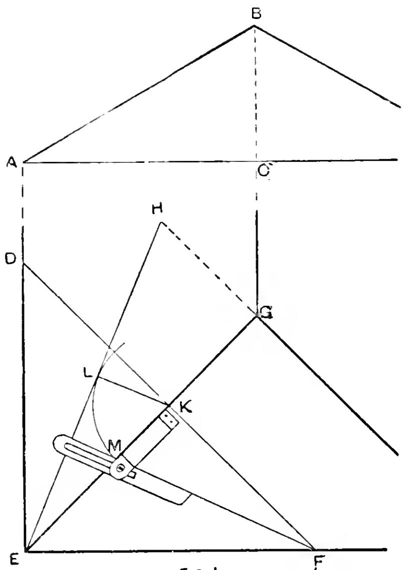


FIG. 1

E H is the pitch of the hip. In E G take any point, as K, and at right angles to this line draw D F through K. With K as centre draw the arc L M tangent to E H as shown, join M F, which is the angle of the backing. Set the bevel to the drawing as shown. Fig. 2 is a sketch showing the bevel being applied to the hip. A drawing as shown at Fig. 1 can be sketched on a board to about 1 in. scale on a building, and it will be found to take up much less time than the rule-of-thumb method of guess and trial. If work is to be done properly and without mistakes, time must be allowed to set it out. There is no other proper way.

Re-tinning Copper Vessels.—The object of tinning copper stewpans is to prevent chemical action on the copper, which may be injurious to health. It also gives a much better appearance to copper cooking utensils, besides facilitating their being kept clean. To ensure success in re-tinning, the article must be perfectly free from grease or dirt—in fact, it must be chemically clean. For this purpose, first burn off all grease and dirt over a forge fire or with a blow-pipe until the article is heated to a dull red colour, being particular where the handles are riveted on. Now wipe out the inside with a small pad of tow, and set down to cool, and when cold, thoroughly scour the inside with wet rough sand or powdered coke until it becomes clean and bright. If the dirt has eaten into the metal, or if the surface is very black, wash it with raw spirit of salts (hydrochloric acid), using a piece of tow tied to the end of a short stick. Rinse with cold water, and then scour bright. When perfectly bright, wash the article well with cold water, taking care that no grit or sand remains inside, and then dust the inside with powdered sal-ammoniac. The outside must be prepared by coating it with a mixture of salt and whiting, which should be of the consistency of cream; this prevents any tin adhering to the outside. If the top of the outside requires to be tinned to the depth of about 1 in., as is the case with all new stewpans, it should be thoroughly cleaned as before explained. A band of tin 1 in. deep should be tightly held round the top of the stewpan, while the mixture of salt and whiting is rubbed over the stewpan below the band. Now remove the band, and dust the bright surface of the stewpan, formerly covered with the tin band, with sal-ammoniac. A rubber, by which the molten tin is manipulated over the copper surface, is made as follows. Coil the end of a piece of ⅛-in. wire, about 18 in. long, until it is about 2 in. in diameter, and tin the coil by soaking it in raw spirit of salts for some time, and then dipping it in a saturated solution of sal-ammoniac and killed spirit (chloride of zinc), and rubbing whilst hot on block tin or tinman's solder. Place the stewpan over a forge fire, and in it drop a small quantity of pure block tin; the amount of tin depends on the size of the vessel. The tin will soon melt, after which it must be rubbed over the copper with the rubber until the surface of the copper alloys with the tin. Any difficulty in getting this result may be overcome by repeatedly and alternately dusting with powdered sal-ammoniac and vigorously rubbing over the tin with the rubber. The top of the outside of the pan may be more easily tinned with a soldering iron, the solution of sal-ammoniac and chloride of zinc being used instead of the powdered

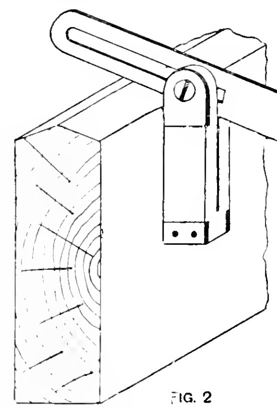


FIG. 2

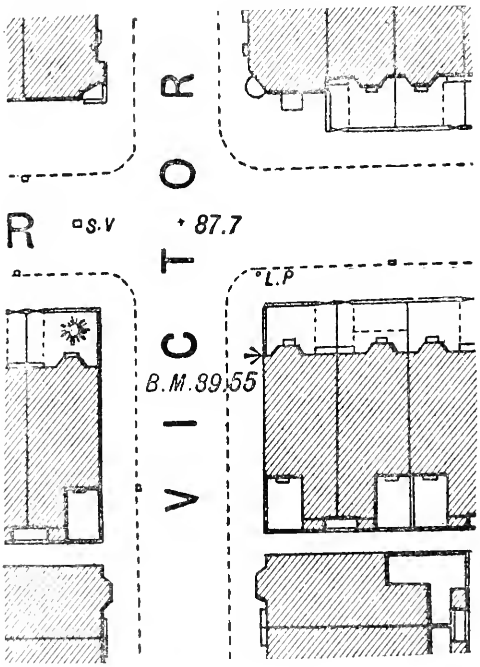
Setting-out the Bevel of a Hip Rafter.

sal-ammoniac. Care should be taken that the article is not allowed to get too hot. The maximum heat is obtained when the molten tin can be rinsed round the inside of the article. The molten tin is then quickly emptied out into another pan, if more than one is to be tinned, and the pan quickly wiped out with a pad of clean tow, which will remove any superfluous tin, after which it must be suddenly plunged into a vessel of cold clean water, and then dried by rubbing with clean hot sawdust. When pouring molten tin from one pan into another, great care should be taken in seeing that the pan into which it is to be poured is perfectly dry and warm, otherwise the possibility of the tin flying will make the operation highly dangerous. If a stewpan, ladle, spoon, or strainer requires to be tinned all over inside and out, it should be thoroughly cleaned, and the inside and outside should then be treated with saturated solution of sal-ammoniac and killed spirit of salts, and then dusted over with powdered sal-ammoniac. A vessel containing molten tin should now be in readiness, into which the article should be carefully plunged and washed. The article is then wiped with tow, plunged in cold clean water, dried with hot sawdust, and polished with whiting.

Developing Negative Films.—Nothing will prevent films curling during development, unless some mechanical means of keeping flat the film is adopted. A very good plan, however, with small films such as those of pocket kodaks is to roll the film, with the sensitised side outwards, round a bottle, the film being held in place with circular rubber bands; the bottle is then revolved in a deep dish well filled with developing solution. Such treatment does not of course permit errors of exposure to be corrected during development. Special frames are made for printing from films, but ordinary frames can be used, the film being laid on glass.

Painting Cardboard for Slate Pencil Writing.—The composition for painting cardboard so as to produce a surface that can be written on with slate pencil is similar to that used for blackboards. Four ounces of shellac should be dissolved in 1 qt. of methylated spirit, and then ground with 1¼ oz. of flour emery, 2 oz. of ivory black, and 1 oz. of ultramarine blue. Other blackboard dressings are given on p. 230. Before using, the solution should be thoroughly shaken; a little is then poured out into a dish and evenly applied with a brush. Two or more coats will be required. If the cardboard is very porous, a coat of very thin size may first be applied.

Ordnance Datum.—The Ordnance datum is an imaginary horizontal plane extending over the whole country at the same height as the average mean level of the sea at Liverpool. This datum was fixed by the surveyors of the Ordnance Department, and the levels of districts are marked on the Ordnance maps as being so many feet above the Ordnance datum, that is, above the average sea-level at Liverpool. The accompanying illustration shows a small portion of the $\frac{1}{500}$ Ordnance



Ordnance Datum.

map. At the corner of the house a bench-mark has been cut (these are usually about 1 ft. 6 in. above the surface of the ground), and the figures indicate that the point is at a height of 89·55 ft. above Ordnance datum. The figure in the roadway indicates that the road at that point is about 87·7 ft. above the datum, the second place of decimals not being given.

Polishing Brass Tube.—Brass tubes are prepared for polishing by being floated with a file, the teeth of which act as cutters and take off the top skin of the metal. Instead of floating, the tubes may be polished by grinding with an emery wheel of about 150 fineness. This wheel, 12 in. in diameter, is fixed on the end of the polishing spindle by means of a false nose, the wheel being held in place by a nut screwed tight on the end of the thread of the spindle. On the bench is fixed a large compound slide-rest with an arrangement to carry the tube; a table is placed both in front and at back of the slide-rest to prevent the tube bobbing about. The advantage of the slide-rest is that any size of tube from ⅜ in. to 2 in. may be ground by simply raising or lowering the tool-holder and the tube carrier. The tube is placed on the carrier and adjusted till there is the slightest pressure or allowance for grinding by the wheel. The side of the wheel, not the edge, is used to grind with, and the tube is passed between the rest and the wheel, which takes off from the tube, with a circular motion, the thinnest possible amount of brass. Each side is served in this manner. Tubes are ground much more quickly by this method than by hand floating. After grinding, the tubes are treated with ordinary polishing sand and finally finished off with the ordinary cotton mop and compo. The mops should be closely sewn together, the rows of stitching being about ⅜ in. apart. They are further strengthened by bolting together with four ordinary snap-head, square-shank ¼-in. diameter iron pins with nuts.

Cleaning Paraffin Barrel.—Paraffin oil cannot be removed from the pores of a wooden barrel by chemical means. If the barrel is to be used for storing water, the oil could be removed by knocking out one end of the barrel and placing some lighted shavings in the barrel. After the oil has been burnt out the barrel may be covered with boards and earth until the flame has disappeared. The charcoal formed by the partial burning of the wood in the interior of the barrel will be an advantage rather than otherwise in a water-butt. The only alternative plan is to take one end out of the barrel and leave it in the open air until all the paraffin oil has evaporated, then give the inside of the barrel a coat of slaked lime, thinned to a cream with water. This will take longer, but will be safer than the first method.

Gramophone or Phonograph Motor.—Ordinary brass clock wheels will do for a clockwork gramophone or phonograph motor. The motive power can be the main-spring and main-wheel complete of an eight-day American

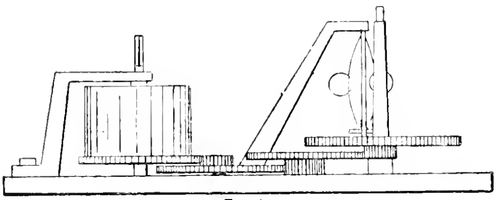


FIG. 1

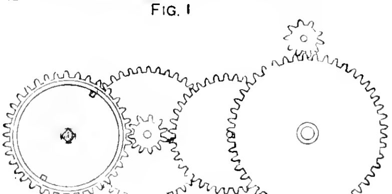


FIG 2

Clockwork Motor for Gramophone or Phonograph.

clock, but a stronger wheel would wear better. The train consists of three wheels and pinions (see Figs. 1 and 2), and each wheel and pinion has a ratio of about 6 to 1. They are controlled by a weight governor like a steam-engine governor. The last wheel of the train carries the discs and drives the governor. The wheels are mounted on studs on a bedplate, as in Fig. 1. The last one, carrying the discs, has a long "pipe."

Recipe for Iron Cement.—Iron cement, used for filling up cracks and blowholes in iron castings by application with a hot iron, may be made as follows. Take by weight 2 parts of sulphur and 1 part of fine blacklead. Place the sulphur in an old iron bowl and hold over a fire till the sulphur begins to melt; then add the blacklead, and stir till all is well mixed and melted. Then pour on an iron slab or smooth stone. To use the composition, a sufficient quantity is broken up, placed in the hole, and soldered in by means of a hot iron, in the same manner as a tinsmith solders sheets. As the fumes of sulphur are very annoying, the material must be melted in a good draught.

Cork Paint for Ships.—"Cork" paint, sometimes used on ships' ironwork to prevent it rusting, is composed principally of white lead, oil, varnish, and quick driers. After the surface to be treated has been scraped and red leaded, the paint is applied, and granulated cork is thrown on to the wet surface; when thoroughly set, the cork is painted over. This method is only adopted where the space is to be utilised for sleeping accommodation, and where the iron is not specified to be covered with wood. This method is rarely employed in the merchant service, but in cruisers, where as little wood as possible is used, cork is freely made use of, being generally mixed up in the paint shop of the yard where the work is done.

Replacing Jewel Hole in Geneva Watch.—The jewel hole in the balance of a Geneva watch is held in position by the thin edge of its setting being burnished over the edge of the jewel. In fitting a new jewel hole, the old one must be pushed out by a flat-pointed peg, and the edge of the setting raised by very carefully running the smooth point of a centre-punch round it. After fitting the new hole, which should go tightly into its recess, the thin edge must be once more burnished over the edge of the stone by running the centre-punch point round it, using a little oil as a lubricant.

Fire-cracks in Plaster Walls.—Fire-cracks (which in some parts of England are called air-cracks) in plaster walls should be treated before giving the primary coat of paint with a coat of weak glue size (¼ lb. best Scotch glue to ½ gal. water) applied when the size is quite hot. About 1 sq. yd. should be done at a time, and the size should be wiped off at once with a piece of old rag, the object being merely to fill all the small cracks with size. The surface of the plaster should be carefully wiped, for size should never be used on a plaster surface except for the purpose of filling cracks.

Furnace for Wagon Springs.—Fig. 1 is a cross section and Fig. 2 a longitudinal section of a suitable furnace to be used when making railway wagon springs. A shows the firehole, B the blast inlets, and C the chambers for the spring plates. The products of combustion pass through flues in the bottom of the third chamber, and thence under the floor to a stack in some convenient position. The furnace should be built of brick and lined with firebrick, iron doors being fitted in the usual manner to open with chains, pulleys, and weights or levers. The stays are of cast iron.

Preserving the Colour of Bath Stone.—Repeatedly cleaning off the face of Bath or other stone by rubbing, glasspapering, etc., is to be deprecated, as it removes the natural skin, and, by opening the pores of the stone, makes it absorbent. Treatment with Fluate or the Szerelmey liquid will give the surface of the stone a siliceous skin, closing the pores, and making the stone non-absorbent. Neither of these preservatives will appreciably alter the colour of the stone, although it is probable that in time the stone will become a little darker. An alternative plan is to paint the stone with a flatting coat of white lead mixed with turps and a very little linseed oil; this leaves a dead surface without gloss and not unlike that of distemper, and is also a preservative.

Re-painting and Re-lacquering Bedstead.—In re-painting and re-lacquering a half-tester bedstead it is necessary that first the brass headrail and footrail be taken to pieces. Thoroughly clean off the whole of the old paint with a shavehook or other tool, then rub down the iron perfectly smooth. Mix a quantity of one of the following mixtures: (1) Ivory black and shellac varnish. (2) Melt ½ lb. of asphaltum, and add 1 lb. of hot balsam of copaiba, and when mixed thin down with hot oil of turpentine. (3) Grind ivory black very smooth with turps on a marble slab with a muller, and add copal varnish till the paint is of the proper consistency; sufficient varnish only must be used to cause the colours to bind and dry firm and work free without becoming either sticky or shiny. The ironwork must then be carefully painted with the varnish by means of a camel-hair brush. About three to five coats must be given, each coat being dried in an oven heated to about 300° F., and if possible the heat must be gradually increased, but not to such a point as will calcine the paint. When sufficient body has been laid on, the work will be ready for polishing; this is done in most cases by rubbing down with a piece of felt dipped in tripoli or very finely powdered pumice-stone. Towards the end of the rubbing add a little oil, and when the work appears bright and glossy rub with oil only. Care must be taken that there is no grit in the polishing medium, or the work will be scratched all over and spoilt. Finish off with a soft cotton or silk duster. The brass part of the bedstead must be boiled for about twenty minutes in a strong solution of soda or potash—say ½ lb. of potash and 1 gal. of water; then well wash in clean cold water and dry. If the old lacquer has been removed, dip the parts in aquafortis by means of brass tongs; when quite bright and clean, plunge in clean cold water, and dry in warm sawdust. The re-lacquering may then be done. It will be better to obtain the lacquer ready made. It must be applied with a large flat camel-hair brush, and the pieces of tubing laid on a hot stove or in an oven to set the lacquer. The various parts of the rails may now be put together, and the bedstead set up again.

Burnt Ballast for Mortar. — Where clean sharp sand cannot be had, burnt clay ballast or coke breeze are very good substitutes. Coal slack is not to be recommended. The coke breeze should be obtained from the nearest gasworks. The burnt ballast may be prepared in the following manner, the object being to burn the clay hard, as in brickmaking. Four or five old drain pipes, 9 in. or 12 in. diameter, are laid in line with open joints. Around one end of the flue so formed is placed a heap of wood, say 3 ft. high and 6 ft. across the base. Over this conical shaped heap of wood is spread a good layer of coal, and on the coal a layer of clay 6 in. or 8 in. thick may be deposited. Before attempting to burn the clay, it should be well turned over, and tempered and dried in the air. When the fire is burning fairly well, more coal or breeze is added, and, when everything is red hot, another layer of clay. More coal and more clay are in this manner added to the heap, until it becomes so large that further additions to it cannot conveniently be made. The fire is then allowed to die down, and the ballast is broken up and taken to the mortar mill. One cubic yard of clay measured in the solid, before digging, will, when burnt and broken up, make 1¼ cub. yd. to 1½ cub. yd., and will weigh about 1 ton. From ¾ cwt. to 1 cwt. of coal is required to burn 1 cub. yd. of clay; or, according to some authorities, about 11 cub. yd. of breeze and 4 tons of coal, including slack, will burn 100 cub. yd. of clay.

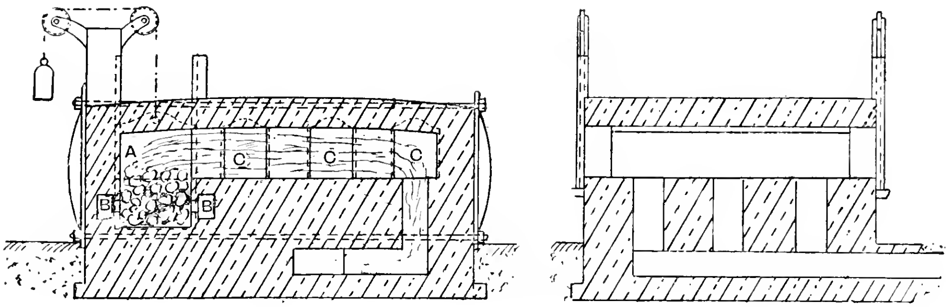


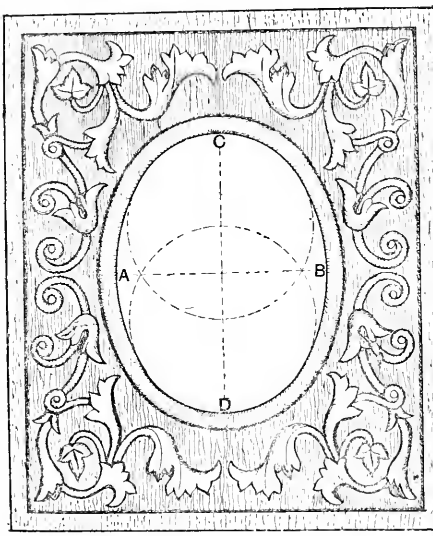
FIG. 1 FIG 2

Furnace for Wagon Springs.

Taking Soundings of Ship's Well.—On each side of a ship's keelson there are "limber holes," which allow the bilge water to pass freely to the lowest part of the compartment, where there is an iron perforated casing to keep out rust chips or other sediment that would prevent correct soundings. These casings are about 15 in. in diameter, and one is fitted alongside the keelson in each compartment at the lowest point (which is aft in the fore-body compartments and forward in those of the after-body). Any leakage or cargo sweat is free to run down the skin between the frame or ribs to the limbers. The sounding tool is an iron rod 2 ft. or 2 ft. 6 in. long, attached to a small line. The ship's carpenter chalks this rod and drops it into the casing or well (keeping it vertical, of course). The well soundings are entered in the log book in inches twice daily. The iron rod is notched with a file at every inch. Some steamers with several compartments have limber holes in some of those which can be immediately closed, in case of collision, etc., by a screw sluice door manipulated from the main deck.

Removing Cannon Pinion from Keyless Watch.—In removing from a keyless watch a cannon pinion that is fixed very tightly, if there is a square at the back take hold of it with a pair of cutting nippers in one hand and grasp the body of the cannon pinion with a pair of brass-nosed pliers held in the other hand, and twist the pinion off. If it cannot be removed in this manner, or if there is no square at the back to hold, the centre arbor must be punched through with a small-pointed punch that will just enter the cannon pinion without damaging it. The watch should rest on a stake or piece of boxwood with a hole in it under the centre arbor. One smart tap should send the centre arbor through.

Design for a Carved Photo Frame.—Walnut, oak, or canary wood is suitable for constructing the photograph frame here illustrated. It should be about $\frac{3}{4}$ in. or 1 in. thick, and $10\frac{3}{4}$ in. long by 9 in. wide. The outside margin is $\frac{3}{8}$ in.; the size of the inner oval, from A to B, $4\frac{1}{2}$ in.; from C to D $5\frac{3}{4}$ in.; and the outer oval is $\frac{3}{8}$ in. larger all round. The oval could be made larger or smaller, to suit the photo; the dotted lines show the method of construction. The design is simple and plain, and easy to mark on the wood. If the lines A B and C D are continued to the outer edges of the wood, they will divide it into four

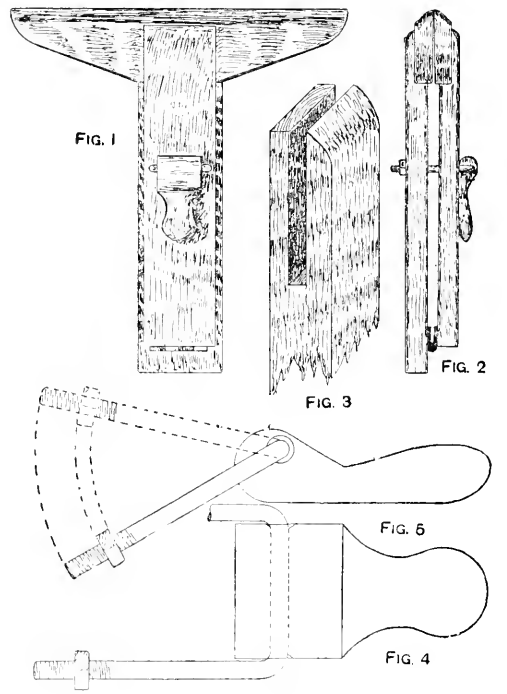


Design for a Carved Photo Frame.

equal parts, and if one part of the design is sketched and taken off on tracing paper, it can be applied to each corner. The ground can be punched or cleaned.

Brazing Brass and Iron.—A brazing spelter for small articles of brass consists of 5 parts copper, 3 parts zinc, and 2 parts silver, alloyed as explained on p. 63. If the seams are not required to stand much working after soldering, they may be joined edge to edge. When seams are formed in this way, little nicks, about $\frac{1}{2}$ in. apart, should be filed out along the edges, so that the solder flowing through the nicks during the soldering operation will render the joint sound. If the seam is to be worked after soldering, a small lap is necessary to ensure adequate strength. To form seams of this type, first thin the edge of the metal along the ends that are to form the seams, about $\frac{1}{8}$ in. in from the edge, so that when the two edges are lapped over each other the combined thickness at the seams will be the same as the single thickness of the metal at other parts. Cut a small cramp at the top and bottom of the seam, and fit the opposite edge in these cramps. After preparing the seams by either of the above methods, fasten binding wire round the articles so as to hold the seams securely in position. Now powder some borax for use as a flux, and soak it in enough water to form a thick paste; place a little of this along the parts to be soldered, and gently heat the article by some suitable means, such as foot bellows and blowpipe, so that it will expand equally, and not disarrange the seam; increase the temperature until the metal is a dull red, and then take a strip of the solder, dip the end in the borax, and, holding the opposite end with the pliers, rub the solder along the seam until a little melts off. Keep the solder in a molten state, and with a piece of wire flattened at one end gently rub the solder along the seam until every part is joined. Small articles of iron may be joined in a similar way with equal parts of copper and zinc, but if the iron is to be hammered much after soldering, 2 parts of copper and 1 part of zinc would be more suitable. With these solders mix equal parts of the borax paste and grains of solder, and along the seams place sufficient of the mixture to solder them when melted. Some dry borax should also be kept ready at hand, so that a little may be taken and thrown on the solder at any point where the material does not appear to be flowing freely.

An Improved Saw-vice.—Figs. 1 and 2 show an ordinary pattern of joiners' saw-vice, differing from others only in the method of tightening up the jaws; Fig. 3 shows the bare-faced tenon for uprights, and Figs. 4 and 5 plan and elevation of eccentric clamp with rod and nuts. The rod is of $\frac{1}{4}$-in. round iron, with thread each end (mild steel would be more suit-

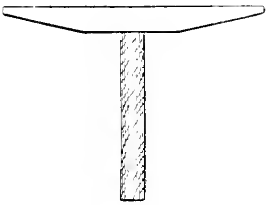


An Improved Saw-vice.

able), the bends being made by heating the iron red hot for the first, and nearly so when placed through the hole in the clamp and bent. This clamp must be shaped out, and the part where it will tighten on the stock by revolving should be smooth and true. Two $\frac{5}{16}$-in holes, which will be $6\frac{1}{2}$ in. down, are bored through both uprights to accommodate the ends of the rod, and collars may be let in flush at the back to tighten the nuts against. When the nuts are adjusted, a saw is instantly clamped by pressing the handle down as shown in Figs. 1 and 2. To release the saw, pull the handle of the eccentric clamp (lever) up. The position of the rod hole is as shown on the handle side of the circle, and farthest from the stock. It will add to the grip to make uprights slightly curved outwards in the middle, and a $2\frac{1}{2}$-in. butt hinge will complete the vice. A strip of vulcanised rubber or leather fastened along the inside edge (top) of jaws will improve the filing.

Cutting Tin-plate.—If a number of pieces of tin-plate the same size and form are to be cut, it is usual to have a punch and die cut to the desired shape; these are fitted to a press, and the pieces are then stamped out. If a limited number only is required, or if the pieces differ in size and shape, a circular hole smaller than the opening required is punched out with a hollow punch upon a lead piece; the nose of a pair of circular snips is then inserted through the hole and the metal cut away to form an opening of the shape desired.

Laying Marble Mosaic Pavement.—The materials commonly used for marble mosaic paving are known as burnt marbles—that is, pure marbles burnt to the desired colours, such as rouge royal (red) and Russe cotto (red), with yellows, blues, greens, and greys of various shades, according to the amount of time spent in burning. The natural marbles used in their original form are chiefly St. Ann's marble and Carrara and Irish green. The cubes may measure about [illegible] in. square, though the size of the cubes depends on the area of the floor to be covered; but the cubes generally used are from [illegible] in. to ¾ in. square, and are either sawn or cut by hand to the required dimensions. For each floor only one size of cube is used. The tesseræ are fixed with a cementing material consisting of chalk lime slaked with water, and left in the open air for several days until it is killed; it is then sifted and mixed with a large proportion of fine crushed brick and water, and well beaten up with wooden beaters into a fine mellowed mortar ready for immediate use. The floor for the reception of the mosaic is generally formed of Portland cement concrete, floated over to a fairly true face; the mortar is now spread evenly on the floor, and the cubes of marble are laid to the required pattern, a small hammer being used for tapping the cubes in until they are solidly bedded. The floor is afterwards rolled with a moderately heavy roller, and then left for a time until the tesseræ are set, when the inequalities on the surface of the floor are rubbed off with specially constructed rubbers of sharp grit stone, water being freely used in the process. The face of the floor is rubbed very fine and left quite smooth, and finally finished off with linen rubbers. But a method very generally followed is to arrange the cubes on paper in the workshop, the first step in carrying out the work being to get out a design for the floor. From this design copies are made at full-size scale, usually on brown paper, ready for the workmen. Great care must be taken to ascertain that the whole of the design is reversed on the brown paper, as, the cubes being laid on the paper in the workshop, the paper would be uppermost on the job, and if the design were not reversed it would show the wrong way. The workman's paper, when finished, is cut up into convenient lengths (about 3 ft. 6 in.), marked with numbers from 1 consecutively, and handed over to the shop workmen, who require the following tools. A scabbling hammer (see illustration), about 11 in. long and 1 in. square, tapered each end and fitted to a short handle, a pair of callipers, an iron block about 9 in. long by 4 in. by 4 in., granite rollers, straightedges, and rubbers. The workman now proceeds to pick out the necessary colours of cubes, dresses the cubes with the scabbling hammer to suit the design, and covers a portion of the design with a layer of gum, to which he attaches the cubes, doing small portions at a time until the whole is completed. The design having been completed by the shop workmen, the whole is forwarded to the scene of the job. The mosaic layer is given a plan of the floor marked with numbers corresponding to those marked on the mosaic paper. Having laid the paving out on the job, the mosaic layer next prepares the cement, to which he fixes the marble slabs. After two or more days, the cement having become set, the paper is cleared off, and the whole of the paving is subjected to considerable rubbing with fine grit stone, attached to a wood handle having a V-groove. The paving is completed by being rubbed to a level.



Scabbling Hammer for Laying Marble Mosaic.

Bronzing Brass Brackets.—Fancy brass brackets, such as gas brackets, are usually only dipped in a nitric acid bath and burnished. If the dipping does not give the desired brightness, the brackets are dipped again and again, and thoroughly washed and dried between each dipping. If the finish is not then suitable the brackets may be dead dipped; this gives a dead yellow surface, and *after* the prominent parts are burnished presents a very artistic appearance. To dead dip, after well pickling the articles, place in stronger nitric acid till a frothy appearance results; then wash in water and dip for a few seconds in the strongest nitric acid. Wash in a bath containing a little dissolved argol or cream of tartar, and dry in warm sawdust; then burnish the articles and lacquer in clear lacquer. A different but equally pleasing appearance may be given to the brackets by bronzing. A bath that imparts to brass a shade from brown to a deep red can be made by dissolving 2 oz. of nitrate of iron and 2 oz. of hyposulphite of soda in 1 pt. of water. Immerse the articles in this till they are of the required tint. For a shade from a pale green to a deep olive green, add 1 part of perchloride of iron to 2 parts of water. For a dark green tint take 1 pt. of water, 1 oz. of nitric acid, and ½ oz. of nitrate of copper. A bronze which gives a very good finish is composed of 1 part oxide of iron, 1 part white arsenic, and 12 parts hydrochloric acid. All grease must first be removed from the articles and the bronze painted on with a brush. When dry the articles may be burnished in the usual way in part, or plain lacquered with a clear lacquer, or they may be plain varnished, according to taste.

How to Make a Chemical Tank for a Magic Lantern.—The following are instructions on making a small chemical tank for magic lantern experiments. Procure three glass plates 3¼ in. by 1¼ in. From one of these plates a half-circle must be cut out with a diamond, using a half-circle of wood as a guide. Canada balsam is used as the cement. It must be placed in a saucer and baked in the oven until it is quite hard when cold. The three pieces of glass should now be heated in the oven or on an iron plate placed over a burner until they are too hot to be touched by the hand. The melted Canada balsam must now be spread with a smooth stick on both sides of the glass plate from which the half-circle has been cut, the other plates being pressed one on each side of it to remove all air bubbles. The whole should then be placed under a weight till cold. The tank thus made will appear like Fig. 1, and may be placed in an ordinary carrier. With a lantern suitable for experiments requiring a wider tank two 4¼-in. by 4¼-in. plates may be used, cementing them together as described above by three pieces of plate glass, the bottom piece 4¼ in. by ¾ in. and the two side pieces each 3½ in. by ¾ in. to form a rectangular tank 3½ in. by 2¾ in. by about ½ in. deep (see Fig. 2). These measurements may be altered if necessary to suit the lantern.

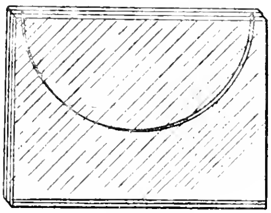


FIG. 1

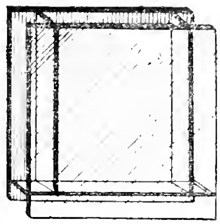


FIG. 2

Chemical Tank for Magic Lantern.

Remedying Pinholes in Photographic Negatives.—Ordinary water colours are best for stopping pinholes in negatives. Almost any colour will do; but the work is more easily and better done when a colour that matches the tint of the negative is used, such as ivory black. The colour should be applied with a good sable brush, No. 2 being the best size. Rub a little of the paint on the smooth side of a piece of opal or even a piece of glass, and take up a little colour with the brush, drawing it with a circular motion to a fine point. If the brush is too wet the paint will run round the spot, and not in it. A white ring round a black spot only makes the spot more noticeable on a print. With the top of the brush touch the exact centre of the spot slowly but very delicately. In some few cases where the film has disappeared it is impossible to remove all traces of the spot; and in such cases it is advisable to fill in the spot densely on the negative, and paint over the white spot on the print. Exceedingly small pinholes, sometimes met with in clusters, are best left alone. A black spot on a print is less noticeable than a white one. Spots are usually the result of dusty slides or camera or dark room, the dust being finally deposited on the face of the plate. Soaking a plate in water before developing is liable with some plates to cause pinholes, the minute air balls that then form on the surface of the plate preventing the action of the developer.

Finishing Stair Balusters Green and Bronze.—Some stair balusters are to be painted two coats, finishing green and bronze. The first coat should be lead-colour paint, and when this is dry give a coat of bronze green made from drop black (about one-third) and yellow ochre (about two-thirds). Thin with benzoline, adding a few drops of terebine as a drier. Put the bronze in a pint pot, cover it well with turpentine (which will extract the verdigris), and let it stand for six or seven hours, after which the turpentine should be thrown away and fresh turpentine added. Varnish the balusters, and when the varnish is nearly dry dip a piece of plush velvet in the bronze, and apply to the projecting points of the balusters. This should be done while the varnish is tacky, so that the bronze may dry with the varnish.

Making Copper Foot-warmer.—To make a foot-warmer, cut a piece of No. 22 or No. 24 sheet copper to 22 in. long by 12 in. wide. Scour it thoroughly with wet sand, and tin one side of it over a coke fire with block tin, using sal-ammoniac as a flux. When the tin has alloyed itself with the surface of the copper, wipe off with a pad of tow, and immediately immerse it in clean cold water, afterwards cleaning with silver sand, and then drying with hot sawdust. Punch a hole for a feeder screw A (Fig. 1) in the centre of the length 1½ in. from the edge. The copper should now be planished with a planishing hammer on a tinsmith's bright anvil. This will close the "grain," thus increasing the durability, as well as developing a bright, smooth surface. Two edges opposite each other should now be set off the ends on a hatchet stake, so that when the copper is bent to shape the edges will clip each other. The bending can best be done over a narrow mandrel, and the edges must be "grooved" inside. When this has been done the section will appear as in Fig. 2. Solder the feeder screw in the hole from the inside, and similarly the grooved joint, leaving a good body of metal on each. This constitutes the body of the foot-warmer. To make the ends, up-end the body on a piece of copper, and mark around. Allow a ¼-in. edge extra, cut the copper, and mark and cut out another one from it. These pieces should be cleaned, tinned, and planished, etc., as previously described. Then they should be slightly hollowed (both together) on a wooden block with a hollowing hammer. Now crease or "jenny" the edges so as to fit the body tightly. Before these pieces are finally fixed, two handles B (Fig. 1) must be made from No. 8 brass wire, each with a copper plate which is riveted to the end, as shown. Solder over the heads of the rivets inside, fit each end on, and solder well round. The superfluous solder may be removed by a steel scraper or a smooth file. Rub well with emery cloth, and finish with crocus and oil.

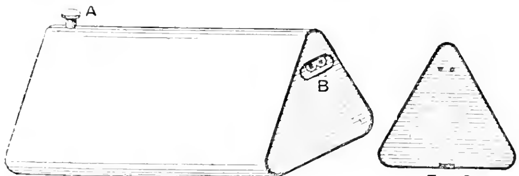


Fig. 1 Fig. 2

Making Copper Foot-warmer.

Particulars of Cellulose.—Cellulose is an organic product having the same composition as starch, and is a similar composition to sugar, *i.e.* $C_6H_{10}O_5$. The purest cellulose is sold by chemists, etc., as cotton-wool for medical purposes; the cotton fibres, linen, wood of all kinds, paper, etc., are all more or less impure forms of cellulose.

Buff Balling Bottoms of Boots.—To make out the bottom of a boot, the sole should be buffed or scraped with the buff knife, that has been well sharpened till it has a keen, regular edge. Only the first layer of grain is taken off the sole; when this has been carefully done and the sole has been well sandpapered, it should have a fine velvet-like surface. It is, however, very hard to produce in this way a white bottom upon bad leather, or upon good leather improperly worked. With a soft brush remove all the dust of leather made by this process, and scrape some buff ball all over the bottom, and with a fine piece of sandpaper work it evenly all over the sole, and then smooth it down with the back of the paper. With a clean soft piece of flannel, lightly damp down the whole of the sole, doing it evenly all over, so that the leather just changes its colour; then scrape some buff ball all over the sole while it is damp. Hold the boot firmly between the knees, and with a hare's foot or piece of soft flannel dab the buff ball down to cover the sole. Finish by brushing off any loose dust with the hare's foot.

Wiping Joints on Copper Pipes.—Wiped joints on copper pipes are longer than wiped joints on lead or composition pipes. Copper pipes 2 in. or more in diameter have joints from 2½ in. to 3 in. long; 4-in. pipes have joints about 4 in. long; but it must be remembered that whilst reasonable length and thickness of joint are necessary to enable the copper pipe to withstand pressure and strain, the maximum time of service does not depend on the length or thickness of the joint as in lead-pipe work. That which determines practically the life of the joint is the extent of pipe which is carefully tinned before forming the wiped joint. If the interiors of the two pipe ends are tinned, say, for 6 in. or 8 in., on cutting open the joint in a few years' time, it is found that the tinning has diminished to 2 in. or 3 in., a corroding action having taken place at the end of the tinning; for this reason it is advisable that the tinning be fairly thick, so as to retard the separation and ultimate failure of the joint. In tinning copper, first thoroughly clean it with dilute sulphuric acid or scour with sand and water, and then rinse it with chloride of zinc, known as killed spirit. Melt some pure tin, throw in sal-ammoniac as a flux, and dip the copper in the tin, or pour or rub the latter over the copper. In pipes forming a portion of a distillery plant it is especially important that no untinned spots are left on the interiors of the pipe ends, as at such spots the destruction of the tinning commences at once. In Fig. 1, which is a part sectional view of the two pipe ends prepared for jointing, A shows the extent of the tinning, which is on the exterior and interior of the pipe ends and on the edges also. Fig. 2 shows the tinned ends slipped together ready for wiping, the form of the required joint being shown by the dotted lines. The pipe is strengthened by putting one pipe within the other, and the corrosion of the tinning is arrested when it reaches the lap. If sufficient lap is given, the pipe may be handled before the joint is wiped—a great convenience. The pipe ends are placed together, when practicable, over the iron pot containing the molten solder, which is then poured continuously over the joint until a heat is got up. This practice is not possible with lead or brass pipes, because in the one case the lead would melt, and in the other the molten zinc would leave the brass and ruin the solder. When the pipes cannot be moved, a grain scoop (a kind of shovel) is placed beneath the joint and the solder poured on rapidly. When a thorough heat has been obtained, the joint can be wiped, with the aid of a cloth and of the mushy solder from the scoop, in much the same way as a joint on a lead pipe is wiped, the latter operation being described on p. 88.

Fig. 1

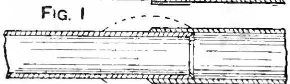


Fig. 2

Wiping Joints on Copper Pipes.

Adjusting a Watch in Positions.—Provided there are no faults in the escapement, pivots, or jewel holes, the adjusting of a watch in positions is mainly a question of exact poise of the balance. The balance, with its pivots perfectly clean, should be placed on a poising tool and carefully tested. In a plain balance, filing the inside under edge of the rim will poise it. In a compensation balance, small errors can be altered by manipulating the four "quarter screws"—that is, those with long taps. Larger errors must be corrected by altering the weight of the screws. When perfectly poised, the watch will be very nearly correct in different positions. A loss in any one position generally indicates that when the movement is held in that position, and the balance is at rest, the top of the balance rim is too heavy.

Removing Ink Stains from Bone Handles.—To remove dirt from bone knife-handles scrub with hot soap and water, and wash well with clean water; rub on a solution of oxalic acid to remove ink stains. Again wash, dry, and polish with a chamois leather and whiting.

Traveller's Sample Case.—Figs. 1 to 5 show the construction of a traveller's sample case. Good red deal, birch, beech, or other similar hardwood, $\frac{3}{4}$ in. to 1 in. thick, may be used, according to strength and other requirements. The angles should be dovetailed together, and the boards jointed and cross-tongued, as shown at Fig. 4. To prevent dust, etc., getting in, a fillet about $1\frac{1}{4}$ in. by $\frac{3}{8}$ in. should be nailed round so as to project into the lid when closed (see Fig. 3). If the staples are made as shown at Fig. 5, they can be screwed to the front of the rim of the lid, and the returned piece shown at A (Fig. 5) can be let in and screwed to the underside of the lid; this will prevent it being broken off. The eye and plate can be made so that the eye

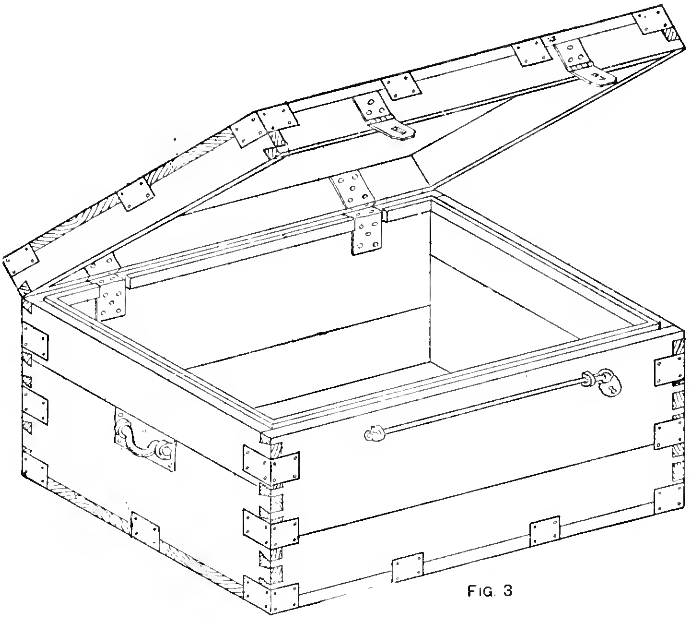


FIG. 3

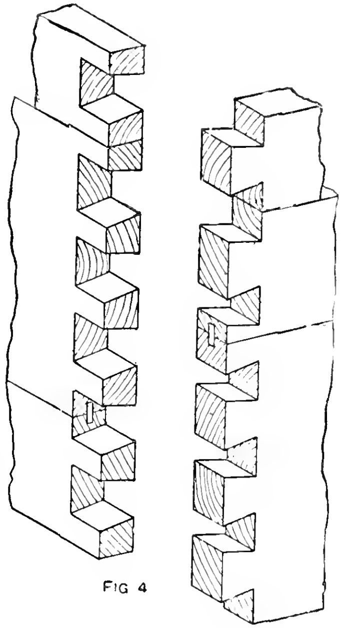


FIG 4

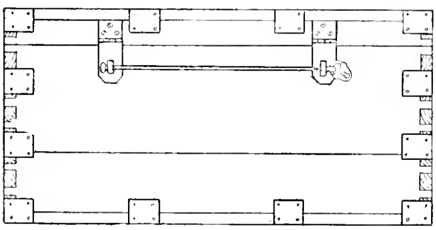


FIG 1

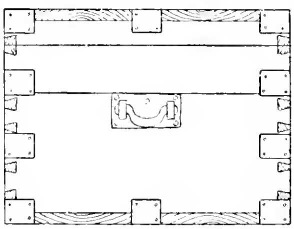


FIG 2

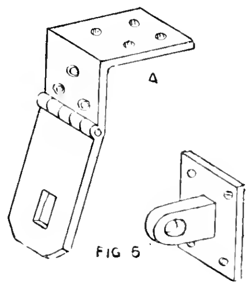


FIG 5

Traveller's Sample Case.

passes through the front, the plate being screwed to the inside; it is thus not likely to be broken off or unscrewed from the outside. Two padlocks may be used, or a rod and one lock, as shown in the illustrations. For ordinary purposes, one staple, eye, and lock would be found sufficient.

Lining a Wooden Tank with Lead.—In lining with lead a wooden tank 20 ft. by 9 ft. by 4 ft. deep, first divide the bottom of the tank into three parts. This gives two seams across the bottom, and where the seams come the woodwork should be dished for the soldering to be wiped flush. The lead for each end of the tank can be in one piece, and if plenty of help is available, the sides could also be each in one piece. But if the tank is in a cramped position where the extra hands cannot exert their full strength, each of the sides can be lined with two pieces, dishings being made in the woodwork for flush seams to be wiped upright in the centre of their length. For rain water, the sides and ends should be of 7-lb. lead, and the bottom of 8-lb. lead; but if economy must be studied, 6-lb. lead sides and ends, and 7-lb. lead bottom, would do. To line the tank, first put in the sides, then the ends, and the bottom last of all. After the lead is in position, the upright flush seams and the upright angles should be soldered, then the bottom flush seams, and lastly the bottom angles. It is assumed that sufficient knowledge is possessed to arrange the laps so that the solder will not run through when wiping, and also to prepare the work for soldering. Upright stiffening pieces wiped on to the sides are better than dots; but if it is found necessary to fix stay rods to keep the sides from bulging outwards, these rods would also help to support the lead, and prevent it from bagging as the tank is emptied of water.

Silver Solder for Soldering Copper.—A silver solder for soldering copper is composed of 5 parts of copper, 3 parts of zinc, and 2 parts of silver. Melt the copper first, then add the silver, and lastly the zinc; directly the zinc is immersed, rapidly stir the alloy so as to render its composition equal throughout, and then cast it in a small ingot mould. The ingot is then rolled down to form a small sheet equal to about No. 18 B.W.G. gauge in thickness, and from this narrow strips are cut as required. Ordinary solder may be converted into fine solder by melting and then adding the silver in the proportion given above.

Separating Gold from Ashes.—A simple way of separating gold from ashes is to mix the ashes with borax and melt down in a crucible. For this purpose the highest heat of a wind furnace will be required. If the ashes contain traces of other metals besides gold, it would be best to boil first with water several times to get rid of soluble matter, then with aqua regia (3 parts of strong hydrochloric acid to 1 part of strong nitric acid) in a porcelain dish, using a fume chamber or chimney to carry away the fumes. After boiling for several hours, water may be added and the liquid filtered. The filtrate will contain the gold and other metals as chloride. A solution of ferrous sulphate (green vitriol) should be added in excess, and the liquid boiled. A brown precipitate will come down; this is pure metallic gold. It may be filtered off, washed several times with water, and dried, when it will form a reddish-brown powder. It may be melted down in a crucible or in a furnace, or fused to a button of metal on charcoal before the blowpipe.

Waterproofing Fishing Lines. — Plaited silk fishing lines are waterproofed by soaking in equal parts of boiled linseed oil and copal varnish, then stretching in some convenient position to dry, at the same time wiping off superfluous dressing with a rag. Drying will take a considerable time; to accelerate it, 1 part of gold size may be used instead of the varnish to 2 parts of boiled oil.

Frame for Wire Blind.—Fig. 1 shows the general form of the frame for a wire window blind. Fig. 2 is an elevation of the joint (A, Fig. 1) to a larger scale. The tenon, mortise, haunch, and wedges are indicated by dotted lines. Fig. 3 shows the construction of the joint, mitreing of the head which is stuck on the solid, and the rebate formed for the movable bead, which is not shown. The beads should be about ½ in.

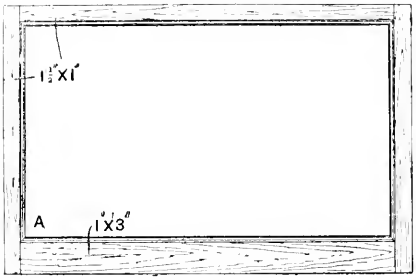


Fig. 1

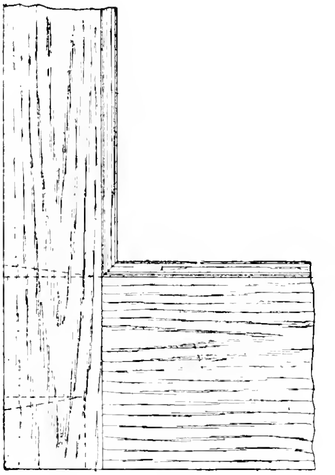


Fig. 2

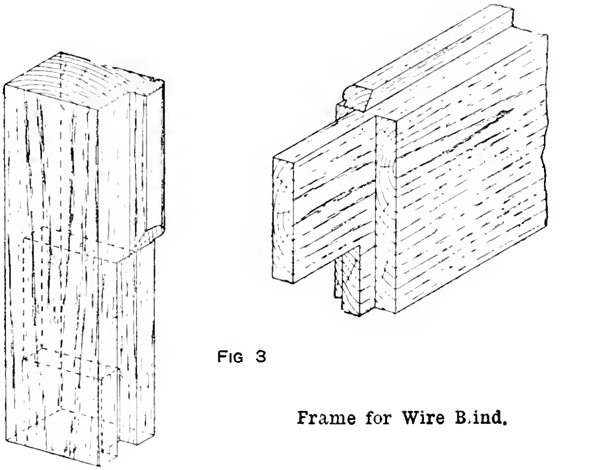


Fig 3

Frame for Wire Blind.

Filtering Cycle Oil.—Dirty cycle or other machinery oil may be filtered through cotton-wool, flannel, or any similar material without affecting its lubricating properties. Flannel is not so good as closely packed cotton-wool, because the fibres are openly felted and the finer dirt can get through. Closely packed cotton-wool makes a slow filter. The best filtering arrangement is a glass or tin funnel placed in a bottle, and a circle of best white blotting paper folded twice and opened to fit the funnel. The oil will pass pretty quickly through the paper. When the blotting paper begins to plug up it may be removed and fresh paper substituted.

Wet-plate Photography.—In wet-plate photography the plates are prepared as they are required, and are developed immediately after exposure. Any camera may be used so long as provision is made in the dark slide to catch the drippings from the plates; a fold of blotting paper will answer this purpose. The following materials will be required for preparing and developing the plates. Mawson's iodised collodion 4 oz., silver nitrate 1 oz., a few pounds of hypo, alcohol 1 oz., acetic acid 1 oz., sulphate of iron 1 oz., an ebonite dipper, and some pieces of clean glass free from air bells. Make up the following solutions. *Silver bath.*—Silver nitrate 1 oz., distilled water 11 oz., iodine 1 gr., nitric acid 2 drops. *Developer.*—Sulphate of iron ¼ oz., alcohol ¼ oz., acetic acid ¼ oz., water 4 oz. Clean the glass by first swilling with water, and, if greasy, washing with a powerful alkali such as caustic soda, and again swilling. Allow the glass to dry spontaneously. When dry, wipe free of dust, and pour in the centre of the plate a pool of the iodised collodion, as in varnishing a negative, and flow first to the top right-hand corner, next to top left-hand corner, then to the bottom left-hand corner, where the plate is balanced by the tip of the thumb, and from the bottom right-hand corner pour off the excess into the bottle. As soon as the collodion has set (which is when the surface becomes dull) immerse the plate in the silver bath by means of the dipper, lowering gently into the solution, where it should remain, rocking occasionally, for about two minutes. As soon as the silver solution wets the plate evenly (this takes longer in cold weather) the plate is sensitised. The sensitising is done in the dark room, and a flat porcelain dish may be used to contain the bath. The plate is gently removed from the bath, and when it has finished dripping it is placed on the wires in the dark slide and exposed in the ordinary way, though for a longer time than a dry plate. The plate must be kept in a vertical position. On removal from the slide the plate is held in the hand, as in coating, and is flooded with the developer. Coating the plate, sensitising, exposing, and developing should follow each other as quickly as possible, or various defects will occur in the plate. As soon as development is complete the plate is immersed in hypo 1 oz., water 6 oz. The used developer and the drippings should be filtered through cotton-wool and saved for use in cases of over-exposure. Should the image be too weak, it may be strengthened or intensified by flooding with pyro 4 gr., water 2 oz., silver bath 1 dr., and 10 per cent. solution of ·880 ammonia a few drops. Wet plates may be varnished with ordinary negative varnish. The ferrotype is merely the wet collodion process for producing positive images on a metal, instead of glass, plate, the image being reversed as regards right and left. The only advantages of the wet collodion process are cheapness, extreme density and contrast in image, and fineness of grain. The process, being dirty and extremely slow, is now seldom used except by itinerant photographers.

Cementing Broken Marble.—As a cement for white marble, use fine plaster-of-Paris mixed to the consistency of thick cream. A thoroughly satisfactory job, however, cannot be made in the case of a mantelpiece, as the repair will show in time. For black or coloured marble use brown or orange lac, obtainable from drysalters or chemists. Warm the broken pieces of marble before the fire, then place on the lac, and when melted press the two pieces together until firmly set—a few minutes will suffice; the superfluous lac should be squeezed out whilst it is warm. If desired, the lac may be prepared in sticks by melting it on a hot plate, adding the requisite colouring matter in the shape of oxides, and then rolling into sticks similar to sealing wax.

Tool Chest for a Light Coach Body Maker.—A tool chest suitable for a light coach body maker may be made of 1-in. sound red deal, free from knots and shakes and perfectly dry. The front and back should be jointed and glued in the centre as A (Fig. 1), the ends having two joints as B (Fig. 2), so that the strain is not on a direct line at the joints. The sides and ends should be dovetailed together, and should be 2 ft. 8½ in. long outside by 1 ft. 6 in. deep over all by 1 ft. 6 in. wide, the plinths being fixed outside this measure. The bottom is screwed on crossways of the length, and is tongued together as shown in Fig. 3. The top is made up lengthways of the grain, glued then finer, then the finest. Now rub briskly with a piece of rag that has been dipped in oil and then into the dust, etc., which has come from the horns during the scraping, filing, etc. The horns should then be smartly rubbed with a rag dipped in whiting and sulphuric acid or vinegar, then with a rag dipped in oil and putty powder (oxide of tin). Now well rub the horns with a dry cloth, then with crumpled paper, and finally with the bare palm. The rubbing at each stage must be thorough; and between every two steps a good dusting of the horn should be given to prevent the larger particles of the one stage scratching the smoother surface gained in the succeeding stage.

Heat Insulating Composition.—The following recipe for a non-conducting composition has been given for use with steam pipes, etc. In water, mix fireclay with four times the quantity of small coal ashes to the consistency of thin mortar. Then mix equal quantities of dry calcined plaster and flour, each constituent equalling in quantity the amount of fireclay previously used. Add to the ash mixture. Two coats should be used, with a setting coat outside, as when plastering a wall.

Cutting Slot in Top of Turned Pillar.—When it is required to cut a slot in the top of a turned pillar, a box similar to the accompanying diagram should be constructed, and in each piece of board two kerfs

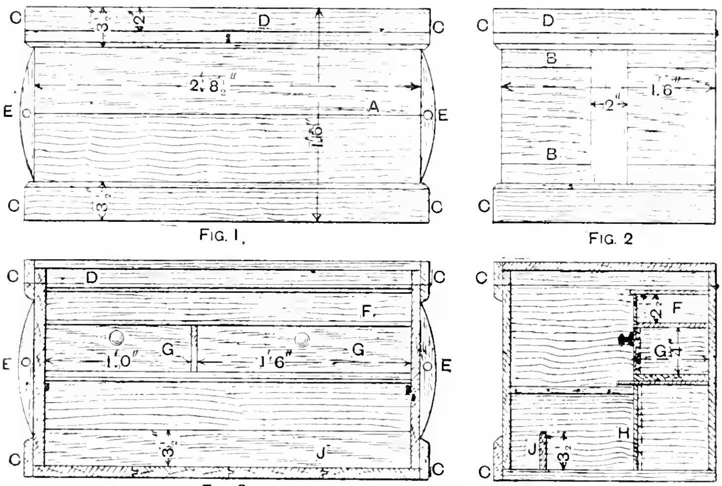
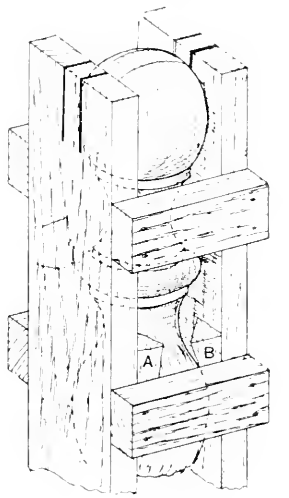


FIG. 1. FIG. 2 FIG. 3 FIG. 4

Tool Chest for a Light Coach Body Maker.



Cutting Slot in Top of Turned Pillar

and jointed in the same manner as the front, and fixed on by screws. The whole is cleaned off, and the plinths C (Figs. 1 to 4), which are 3½ in. deep by ⅞ in. thick, put on flush with the top and bottom, and mitred together at the corners. To form the lid, gauge round from the top edge 2 in. down (see D, Figs. 1 to 3); saw round, keeping true to the line, and then plane off the edges true to a fit. The lid will now be just deep enough to carry a hand and tenon saw when the tools have to be packed for transit. The lid may be hung with 3½-in. wrought butts or cranked cross-garnet hinges, and should have a good double action spring lock. For lifting the box, two pieces of beech 3 in. wide, shaped as E (Figs. 1 and 3), are fixed on the ends by screws from the inside. Holes are made just above the centre (see Figs. 1 and 3); these carry rope handles. The interior of the chest is shown at Figs. 3 and 4, fillets being fixed on the ends to carry a light framing to form the tray F (Figs. 3 and 4) and recess for the drawers G. This framing is supported by a strut fixed inside the casing H, which is made to slide forward; the space beneath the drawers is for working drawings, sizes, etc. A small board J (Figs. 3 and 4) 3½ in. deep is fixed on the bottom and ends to carry compass, smooth, concave, and tee planes. Coat the inside of the chest with pale gold size, and the outside with good lead colour.

Polishing Goat's Horns.—In polishing a pair of goat's horns, remove any rough or uneven parts with a spokeshave, then well scrape all over with a cabinet-maker's steel scraper or with the edges at the sides of a woodworker's chisel. When the horn is fairly smooth, go over it with a rasp or file, followed by coarse sandpaper,

should be truly made. The pillar can then be fixed true in the box by a few wooden wedges, as indicated at A and B. The head should next be sawn by allowing the saw to work in the kerfs as when using a mitre box.

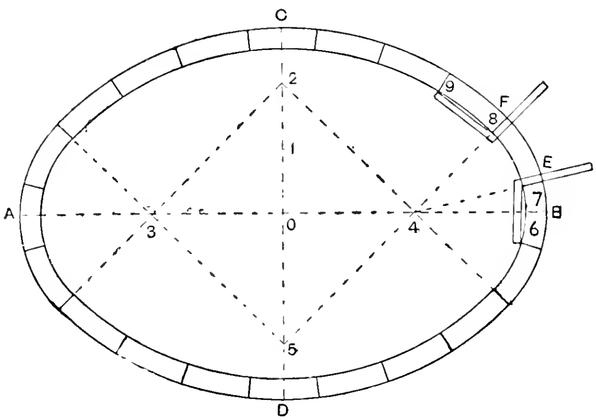
Modelling in Papier-mâché.—In making animal heads with papier-mâché, either a natural skull or one modelled in clay is obtained, and from this a plaster mould is taken. In this mould papier-mâché is forced, or sheet after sheet of pasted paper is pressed in every direction, and forced well into the hollows. When dry, the material easily comes away from the mould. To make papier-mâché, tear into small pieces a number of old newspapers, and boil until quite soft. The pulp should then be removed from the fire and squeezed, some thin glue and plaster-of-Paris added, and the whole beaten well together. If the material is too dry, add glue; if too sticky, add plaster. When rubbed on the hands it should leave a very thin coating.

Cleaning Aquarium Shells.—It is impossible to keep delicate shells fresh and clean at the bottom of an aquarium, for they quickly become covered with a green aquatic growth that defies all efforts to be scrubbed off. The shells may be cleaned by plunging them in a boiling mixture of 1 part of hydrochloric acid to 10 parts of water. Hold them with wooden tongs, and remove after one second to clean cold water. Repeat the operation if necessary, but if the shells remain in the acid beyond the prescribed time they will be eaten in holes, if not altogether dissolved. If the shells are to be replaced in the aquarium, it is not worth while to clean them repeatedly. Introduce a few fresh-water snails into the aquarium, and they will keep down the green growth.

Particulars of Oil of Turpentine.—Oil of turpentine, spirit of turpentine, and ordinary or common turpentine are all the same thing. Crude turpentine is turpentine as it is derived direct from the pine trees. Oil of turpentine really means the essential or volatile oil of turpentine after distillation. Oil of turpentine must not be classed with the ordinary kinds of oils, such as olive oil, etc., which are non-volatile, and have a different composition altogether. There is an oil of turpentine known as fat oil of turpentine, but this is simply ordinary turpentine that has been exposed to air for some time and has become thickened or partly resinified by oxidation.

Yellow Stain for Venetian Blinds.—A high-class satin stain for use on Venetian blind laths previous to varnishing can be obtained by dissolving 1 oz. of gamboge in 1 pt. of methylated spirit. A cheaper plan would be to mix dry yellow ochre, or 2 parts lemon and 1 part orange chrome, in weak glue size. This latter mixture should be brushed on, the surplus being wiped off with soft rag.

Determining Bevels for Joints of Oval Cask.—In finding the correct bevels for the joints of an oval cask first set out the oval or ellipse, and a good method of doing this is shown by the illustration. Let A B and C D be the given diameters. Divide O C into three equal parts. On line A B mark off A 3 and B 4, each equal to O 2. Make O 5 equal to O 2; then draw the radial lines from 2 and 5, passing through 3 and 4 as shown.



Determining Bevels for Joints of Oval Cask.

Then 2 and 5 will be the centres for the larger curves, and 3 and 4 for the smaller. Next set out the staves as shown. It will be seen that two bevels will be required. For the sharper-curved staves, as at B, join the points 6 and 7, then join the radial line 7 4, and draw E bevel as shown; the bevel at F can be obtained in a similar manner. The bevels here given are for application at the centre of the staves.

Forging Axles for Vehicles.—The iron for vehicle axles should be of the best quality. The method of working is as follows. A number of small bars are put up in a bundle sufficient to make an arm, and bound with iron rod to prevent falling about when working. The arm is then placed in the furnace, and thoroughly welded together. Whilst this is being done it is worked somewhat to the required shape. The collars are now made and welded on. For this purpose dies, or top and bottom tools, are used, the arm being worked at as great a heat as possible without burning, lighter heats being taken for finishing to the size required with light blows; afterwards turn and fit the axles. To case-harden, place the articles in an iron box or casing large enough to contain a packing of 2 in. or 3 in. of the hardening compound around each arm. The box should be sealed up air-tight at both ends. The compound generally used is leather shreds, ground raw bones, hydrocarbonated bone black, and sal soda, the whole being placed in a furnace and kept at a good heat for ten or twelve hours; then remove the articles from the box and cool out thoroughly. Where an extra hard casing is required the articles are re-heated, the box being filled with powdered potash and kept in the furnace until the potash is consumed. Where large quantities of axles have to be cooled out the cooling tub should be arranged to have an inlet of cold water at the bottom, so that the water made warm by the work would flow out over the top, thereby ensuring a continuous cool supply. The collar plates are stamped out of No. 6 fender plate, and when solid flaps are made in the axle, these plates have to be cut across one side to allow of bending back to get them on between the collar and the flap.

A Watch-case Galvanometer.—To make a simple galvanometer as in Fig. 1, get an old brass watch case with one of the brass plates removed. In the centre of this drill a very small hole to suit an endstone, such as jewellers use in watches. Then cut a piece of brass to fit across the diameter of the plate, $\frac{1}{8}$ in. wide and $\frac{3}{32}$ in. thick. Drill a hole at each end, and get two small brass pillars for the ends, about $\frac{1}{4}$ in. long by $\frac{1}{8}$ in. in diameter, to raise the cross-bar from the plate. Then drill a central hole in the bar, and put an endstone in this. Taper a piece of watch spring each end from the centre to form a pointer, drill a $\frac{1}{32}$-in. hole in the middle of it, fit a shaft in tight to the hand, and magnetise the pointer; pivot the shaft at the endstones. Next cut a piece of tin to the shape of Fig. 2, lap it with silk tape, varnish, and lap again with about 8 ft. or 9 ft. of No. 28 S.W.G. silk-covered wire. Next get a piece of spring steel, $\frac{1}{16}$ in. in diameter by $1\frac{1}{4}$ in. long, magnetise it, and fasten in cross section to the horseshoe magnet after taping and varnishing. Fasten these two magnets to the back of the brass plate by means of a short piece of ebonite and small screws at the ends. Drill two holes at each side of the case for the reception of two terminals, and connect as shown in Fig. 1. A scale, also, graduated as shown, should be affixed.

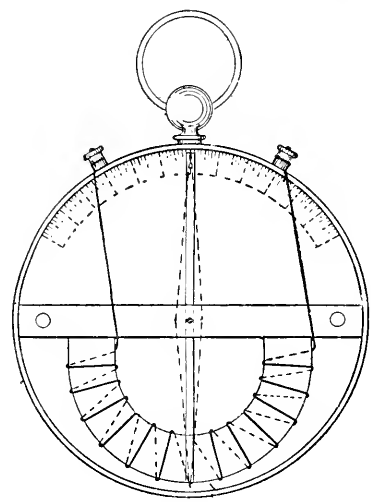


FIG. I

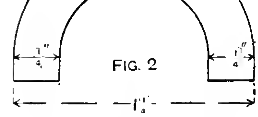


FIG. 2

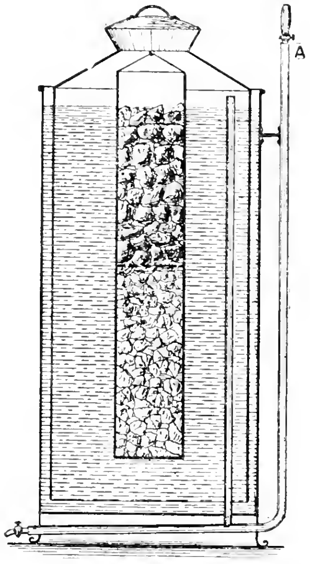
Watch-case Galvanometer.

Soldering a Joint in a Watch Case.—To solder a joint in a watch case, the old joint must first be filed off clean. This should leave a semicircular groove in which the new joint can lie true. The joint is cut from drawn silver or gold tube. Place it in its groove, having first wetted it with borax paste and water. Along its side place a long thin strip of silver or gold solder, and apply a blowpipe flame to the case near the joint until it is well hot; then direct the flame on the joint until the solder runs. As soon as the solder sets, and while the case is hot, plunge it into a pickle made of sulphuric acid 1 part and water 9 parts, then wash in plenty of water, and clean up. Before soldering, unpin the back, bezel, and dome, and take out the bow, push piece, and any steel springs so that they may escape injury from the heat.

Making Black Crayons.—To make black crayons, mix 10 parts of pipeclay, 1 to 1½ parts of lampblack, and ½ part of Prussian blue with water to a stiff paste. Well knead all the ingredients together. Allow the paste to remain for several days, then roll out on a board and cut into lengths. A better method, however, would be to press the crayons in a mould; they would be harder, more homogeneous, and less liable to break.

Green Stain for Oak Picture Mouldings.—To stain oak picture mouldings a bronze green, mix bronze green, procurable at paint stores, in hot vinegar or in dilute French polish. If the mouldings are to be polished, mixing in vinegar is advised. Some of the dry colour may then be mixed with the grain filler and also with the varnish, which will be required on oak in order to gain a solid body.

Acetylene Gas Generator for Magic Lantern.—Herewith is a sketch (one-eighth full size) of a portable and automatic acetylene gas generator for use with a magic lantern. The apparatus works well, and will give about 400 candle-power for about two and a half hours. In the illustration the carbide is shown on top of the lime residue. A is the pipe leading to the lantern, the lamp for which has four burners.

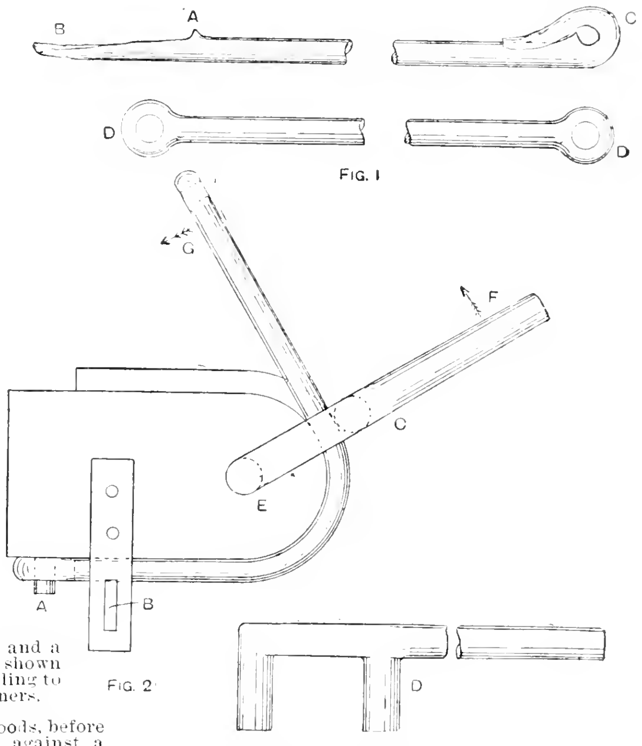


Acetylene Gas Generator for Magic Lantern.

Polishing Tin-plate Goods.—Tin-plate goods, before being polished, are scoured by being held against a revolving mop greased sufficiently for the purpose by contact with a tallow candle. Finish by polishing with a dry mop on which some Sheffield lime is placed. When polishing tinware, the mop should be run at a speed just sufficient to cause it to stand out stiff; if the lathe is run at too high a speed, the mop will remove some of the soft surface tin.

Stains on Marble.—Marble erections against a backing of brickwork will in a year or so's time show a brownish stain, and probably this will gradually spread. The stains are caused by the close proximity of the marble to the brickwork. The marble, being of a crystalline and somewhat absorptive nature, has attracted the damp from the brickwork, and so become discoloured. In nearly all walls, especially those recently built, constant evaporation is taking place, and the effect of this evaporation is to draw the damp from the middle of the wall towards the surface. Marble work, therefore, should never be fixed solidly to a wall, but an air space should be left between it and the brickwork, with an open joint here and there to allow for the condensation that invariably takes place. It may be objected that, by allowing an air space, solid fixing could not be obtained, but this objection may be overcome by the judicious use of brass or copper cramps. There is no permanent remedy for the stains unless the marble-work is detached from the brickwork. The discoloured marble may, however, be bleached by treating it with a solution of soap lyes and whiting, but this bleaching will not be permanent. Mix the soap lyes and whiting to the consistency of a paste, and apply a good coating with an old brush. Let this paste remain on the marble for a couple of days, then wash off with clean water (rain-water for preference), repeating the process two or three times until the stains have been removed. To make the lyes, obtain, say, 7 lb. of American potash from the drysalters, and dissolve in a pailful of rainwater. The lye is of such a caustic nature that it is dangerous to fingers and nails. If, therefore, any of the liquid gets on the hands, they should be at once well washed in water containing a few drops of vinegar or acid to neutralise the alkali.

Making Railway Coupling Shackles.—To get railway couplings to stand, the grain of the iron in the shackles must follow round the eyes. To accomplish this, the bar is first nicked with the fuller as shown at A (Fig. 1), and the end drawn out to form a scarf as at B, which is bent over as at C and welded, the eyes D being finished on the anvil with a pair of tools and a punch. The part between the two eyes is then heated and the bar placed with one of the eyes on the stud of a bending block A (Fig. 2), and fixed by means of a cotter at B. One of the horns of a bending tool C and D (Fig. 2) is placed in a hole E in the block, and the handle pulled round towards the arrow F, the bar following in the direction shown by the arrow G until the shackle is bent to the required shape. Fig. 2 shows the bending block in plan, and C and D are two views of the bending tool. The shackles are made of 1-in. to 1¼-in. Lowmoor or Yorkshire iron, according to the class of vehicles on which they are used.



Making Railway Coupling Shackles.

Cleaning Leather-work Brackets.—To clean a pair of leather-work brackets mix a little carbonate of magnesia with benzoline to form a thin fluid, and apply it, in large quantity, quickly to the leather. Place the brackets in the open air to dry, then with a light feather brush dust out all the dry magnesia. If this does not serve the purpose, the only way of giving the bracket a good appearance will be to cover the leather with a buff flatting paint of a suitable colour.

How to use a Twaddel's Hydrometer.—Twaddel's hydrometers are sold in sets of six or separately; they read as follows:—

No. 1.	0° to 24°	=	sp. gr. of	1·00 to 1·12.
,, 2.	24° ,, 48°	=	,,	1·12 ,, 1·24.
,, 3.	48° ,, 74°	=	,,	1·24 ,, 1·37.
,, 4.	74° ,, 102°	=	,,	1·37 ,, 1·51.
,, 5.	102° ,, 138°	=	,,	1·51 ,, 1·69.
,, 6.	138° ,, 170°	=	,,	1·69 ,, 51·8.

The specific gravity of a liquid is determined by floating one of the hydrometers in some of the liquid, contained in a tall glass cylinder; if the hydrometer is suitable for this particular liquid, the instrument will sink until the surface of the liquid coincides with some mark on the stem of the hydrometer. Suppose the strength of a caustic soda solution is to be determined, and a No. 2 hydrometer is to be used, the level of the liquid reaching 30°, the gravity of the liquid is 30° Tw.; or, if multiplied by 5 and 1·000 be added, its true specific gravity, *i.e.* 1·15, will be obtained; then the solution will be found to contain about 13 per cent. of caustic soda.

Hydraulic Mean Depth.—The hydraulic mean depth of a liquid flowing through a pipe is equal to the sectional area of liquid divided by the wetted perimeter. The the adjustable negative (or film-holder) frame D. This runs in rails like a rising and cross front, and is clamped when in proper position by the thumbscrews E and F. On the inner side of this is a box G fitting closely inside the camera (film end). D is attached to C by the block H, which, resting upon the sides of A, holds everything firm and steady. At J is fitted the front of the enlarging camera, with the opening before the lens and a shallow frame P fitting closely around the kodak. (The kodak Q is, of course, supposed to be removed from its outer box.) Attached to the front by bellows R is a grooved frame K large enough to take a half-plate printing frame—that is, about 8 in. by $6\frac{1}{2}$ in. Through this from the frame runs an iron or brass rod L, over which a staple U may be turned to clamp it and thus hold the frame K tightly in position. When a film is used it is fixed, to keep it flat, between two pieces of glass and inserted in frame D, the film towards K. A sheet of ground glass is then placed in the printing frame, the rough side of the glass towards the operator, and the frame is placed in the grooves S of K, which is then extended almost to the full. D is next extended until the image thrown on the ground glass is nearly sharp. The fine focussing is done by

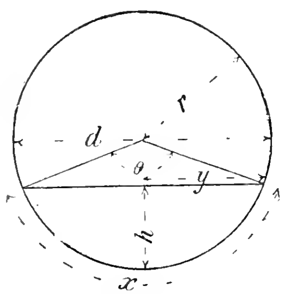
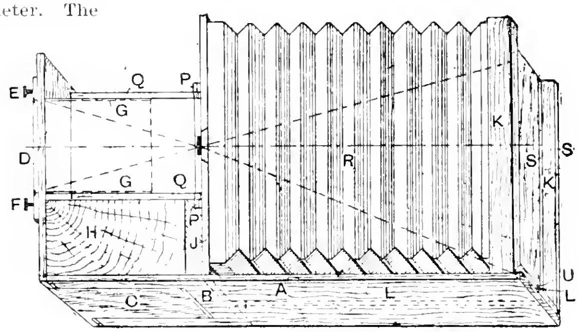


Diagram of Hydraulic Mean Depth.



Enlarging with Pocket Kodak.

sectional area of liquid is equal to $\frac{1}{2} r^2 (\theta - \sin. \theta)$. The wetted perimeter equals $\frac{\pi d \theta}{360}$; ∴ hydraulic mean depth =

$$\frac{\text{sectional area}}{\text{wetted perimeter}} = \frac{\frac{1}{2} r^2 (\theta - \sin. \theta)}{\frac{\pi d \theta}{360}} = \frac{90 r (\theta - \sin. \theta)}{\pi \theta}.$$

Knowing the diameter of the pipe and the depth of the liquid, the angle θ may be found from the equation $\tan \frac{\theta}{2} = \frac{y}{r-h}$, where y equals $\sqrt{(d-h)\, h}$. The hydraulic mean depth for pipes running full or half full is $\frac{d}{4}$.

Power Saw for Soft Stone.—The ordinary frame saw originally intended for sawing hard stone, and driven by power, is now used successfully for sawing Bath and other soft stones, including Beer stone and alabaster. The saw is a long steel blade parallel in width and thickness, from 10 ft. to 12 ft. long, 9 in. wide, and nearly $\frac{1}{4}$ in. thick; it has coarse teeth, with a wide set for clearance; it is easily fixed in the frame by tightening or keying up with a kind of wedge like that used for the hard-stone saw. When in motion the saw is fed with water, sufficient only being used to keep the cut from clogging. The rate of speed (steam power) is from twenty-five to thirty strokes per minute, and a block of Bath stone 8 ft. long by 3 ft. deep can be cut through in from half an hour to three-quarters of an hour, according to the hardness of the stone.

Staining Plaster Panels to Imitate Mahogany.—Cast plaster panels are made to match mahogany in the following manner. Procure three bottles, and place $\frac{1}{2}$ pt. of methylated spirit in each. In No. 1 steep $\frac{1}{2}$ oz. of gamboge; in No. 2 1 oz. of dragon's blood; and in No. 3 1 oz. of red sanders; this will give one shade of yellow and two shades of red. Mix the various shades with an equal bulk of polish; apply with a camel-hair brush. Blend carefully together, building up the desired tones gradually by using the colours weak rather than by trying to get the exact tone by one application. Give the stains a thin coat of spirit varnish, then finish bright or dull as desired.

Enlarging with Pocket Kodak.—A pocket kodak camera may be used for enlarging, as shown in the sketch. A is a baseboard about 15 in. long by $6\frac{1}{2}$ in. wide. The exact dimensions will depend upon the size of the camera and the focus of the lens. A slot is cut at B to take a tongue C about 2 in. long. To this is fitted manipulating K. It is then clamped by U over L. Adjust finally in position by screws E and F. Now replace the ground glass with plain glass and place against it the film side of the bromide paper or plate, and fill in the frame back. Cover the enlarging camera with a thick dark cloth and burn some magnesium ribbon before D. The bromide paper is then developed like a contact print. If only one degree of enlargement is required, the bellows may be replaced by a rigid box.

Extracting Salt from Sheepskin Rug.—Suppose it is required to treat a white sheepskin rug which, during damp weather, becomes covered with moisture. First remove any lining or edging that is on the skin, mix together bran and hot water, and with this mixture immediately cover the bottom of a wooden trough to a good thickness. Upon this place the skin with the wool folded inside. Then place on more bran, fold over again, more bran, and so on until the skin has been completely covered. Then pour on hot water until the whole has been covered. Leave in this state for a day, when the salt will disappear. Wash in clean warm water, and dry in the shade, constantly beating or shaking it. When nearly dry, well rub it.

Watches Stopping in One Position only.—When a watch will go in one position and stop in another, the fault can generally be traced to a defective pivot or pivot-hole; thus, if the watch be held so that the balance works on one pivot or in one pivot-hole, and the watch stops, that pivot or hole is probably damaged. The pivot may be bent, its end may be bruised and resemble a "mushroom," or it may be too short to come through the jewel-hole and touch the endstone. The jewel-hole or endstone may be cracked. Other causes may be too much endshake to the balance; the balance arms may touch the index curb pins or the hairspring stud; the balance rim may touch the balance cock or the watch-plate, or (in a Geneva) the centre wheel; the hairspring may not be flat, and may touch the balance arms or the balance cock; the lever may touch the roller, or the 'scape wheel may touch the top or bottom of the slot in the cylinder.

Preserving Berries.—In preserving winter berries, immerse them in a fairly strong cold brine prepared with ordinary table salt and water. The berries will keep in this way for a long time. Artificial berries are nearly always used for decorative purposes, because of the great difficulty in keeping the natural berries in an unshrivelled state.

Making Waterproof Overalls or Oilskins.—Unbleached calico is generally used for cheap oilskins, fine drill for better-class goods, and sometimes, but rarely, silk. Best linseed oil, with very little driers, is the most suitable dressing, and should take about two months to dry in a cool, airy place. Lampblack is the cheapest suitable black; ivory black is better, but dearer. One pound to 2 lb. of lampblack may be used for 1 gal. of oil. If oil alone is used, 1 lb. to 1½ lb. of driers for 1 gal. of oil may be added; with lampblack, 2 lb. to 3 lb. of driers. Ochre is the only yellow pigment cheap enough to use. If the solution has to be made quickly, use plenty of driers, and hang the articles up to dry in a room artificially heated. The solution should be laid on with a stiff brush or scraper in a thin layer, and the first coat must be allowed to become thoroughly dry before putting on a second; two or three coats will be required. The articles should be hung on sticks so that no two portions of the cloth touch. Boiled oil, coloured with ochre or lampblack, and a dash of driers is also used. It is recommended, in order to keep the oilskins from becoming stiff, that yellow soap cut into shreds should be dissolved in the waterproofing paint, the proportions being 1 oz. of soap to 3 pt. of paint. A little beeswax dissolved in the paint is also used for the same purpose. A good black dressing is boiled oil and lampblack 1 qt., to which the white of five eggs and 1 oz. of melted beeswax are added; give two coats, and allow each coat to dry thoroughly before the next is applied. The drying will occupy quite two weeks. If the drying is not thorough the dressing will become sticky. If driers is used the oilskins are apt to crack. If the dressing is too thickly applied it will peel off where exposed to friction.

Cross in Telescope of a Level.—The cross used in the telescope of a level is fixed in the eye end of the instrument, and just within the focus of the eyepiece, generally 1 in. from the eye end. But this varies according to the focal length of each eyepiece. The wires are taken from the spider, and directly laid over the diaphragm, to which they are attached. Experiments have been made with other material, but the spider's web has proved the best for the purpose. The diaphragm is a ring of metal about ¼ in. less in diameter than that of the tube into which it is inserted. Four screws which pierce through the tube hold it in position and serve for adjustment. The ring is bevelled in its inner circumference in order to provide a clear edge. The face to which the wires are fixed is marked off for the number and position of lines wanted; then the web is stretched across in the marks made, and secured at each end by a drop of varnish.

Comparison of Formulæ for the Discharge of Water in Pipes.—The fundamental formula for calculating the velocity of water flowing through a pipe or channel, and for calculating the rate of discharge, is based on that of Chezy, a French engineer, who proposed in 1775 the formula

$$V = c\sqrt{RS}$$

Where

V = mean velocity of water in feet per second.

R = hydraulic mean depth = $\dfrac{\text{area in sq. ft. of cross-section}}{\text{wetted perimeter in feet}}$

S = slope = $\dfrac{\text{inclination of water surface}}{\text{length of pipe or channel}}$

c = a coefficient determined by experiment and fixed by Chezy at 93·4. This formula was further investigated by Eytelwein, a German experimenter, between 1811-15, and slightly modified, but his form gives practically the same result. The next important formula proposed was that by Neville in the middle of the century, giving a different value for the coefficient c from that of the earlier experimenters. About this time Weisbach introduced his well-known formula, which has been for the last thirty years so much used by hydraulic engineers in this country; it is more complicated than any previous one, a varying coefficient c being given, depending on the rate of the velocity. From 1850 to 1858 M. H. Darcy began in France a remarkable series of experiments on open channels and pipes, on a much larger scale than had previously been attempted. Darcy died in 1858, and his work was continued by his assistant, M. H. Bazin. The latest, and by far the most important, researches on the flow of water are due to Ganguillet and Kutter, of Berne, who published their researches in 1869 and 1870. These experimenters continued on the lines of Darcy and Bazin, and found that the Chezy formula could be adapted to all cases, but that the value of the coefficient c varies under very many conditions instead of remaining constant, as in the early form. Kutter established a series of "coefficients of roughness" which have been largely experimented upon in America, Germany, and England, and have been proved to be substantially accurate. The following table shows more clearly the great difference between different formulæ. Comparison of formulæ:—

PIPES RUNNING FULL—DISCHARGE IN CUBIC FEET PER MINUTE.

Authority for Formula.	Inclination.											
	1 in 50	1 in 150	1 in 80	1 in 250	1 in 500	1 in 100	1 in 300	1 in 750	1 in 500	1 in 1500	1 in 1500	1 in 3000
Chezy	55	32	218	110	99	1253	723	457	3170	1830	5043	3563
Eytelwein	55	32	218	110	99	1256	725	458	3180	1833	5054	3577
Neville	65	35	290	157	106	1509	826	490	—	—	—	—
Weisbach	60	34	268	148	102	1357	779	478	3431	1910	5314	3676
Box (hydraulics) ...	54	31	240	137	97	1230	705	448	—	—	—	—
Darcy	61	35	286	162	113	1485	860	533	3816	2202	6072	4274
Kutter	41	24	225	127	90	1133	654	414	3310	1925	5750	4020
Santo Crimp	51	29	259	147	163	1472	850	533	4181	2375	6891	5033
	6-in. stoneware.		12-in. stoneware.			24-in. brick.			48-in. brick.		72-in. brick.	

New formulæ proposed are either modifications of the Darcy and Bazin or Kutter forms, or, being dependent upon a single isolated experiment, are not entitled to any authority.

Making Gold Wire Name Brooches.—The wire employed for making American name brooches is a hard, tough brass of a gold colour, coated with gold. Various qualities are used, from a lightly gilded wire costing 5s. per pound to a heavily gold-cased wire costing 5s. per ounce. The higher priced wires were first imported under the name of "American rolled gold" wire, but wire of an equal quality is now sold as "seamless gold plating wire." The gauges in general use for this purpose are Nos. 20, 21, and 22, round, and half-round for rings; also square and other shapes for bracelets, scarf pins, and ornamental articles. For name brooches, No. 20 is best suited to bold designs with flowing curves, and No. 21 for more compact forms, whilst No. 22 is only used in making names with small letters. But the condition of the wire also assists or retards the workman in working out his design. A hard wire is liable to break if bent sharply, and is also too springy to retain its shape after being bent; whilst a wire that is too soft, although easily bent whilst making a brooch, will as easily bend and crush out the design after being worn a few times. The tools for this class of work consist only of a pair of small round-nosed pliers, a pair of cutting pliers, and a small fine-cut file; these can be bought at any toolshop. The best designs and patterns for a novice are a few of the lower priced brooches, pins, rings, and bracelets. It is advisable for the beginner to imitate first the simpler designs, such as for an initial scarf pin, in some cheap wire, until a certain proficiency has been attained. Hard-drawn copper wire of No. 20 gauge will be found suitable for this purpose. The stem of the pin may be grooved spirally with one edge of the file, and pointed with the same tool. Twisted pins are made with square wire, held in one pair of pliers and twisted with another pair. When proficiency has been attained in making scarf pins, a safety pin, or a brooch with a simple, short name, may be attempted. Skill in working the wire can be attained only by first practising on copper or some other cheap material.

Design for a Doll's Wooden Bedstead.—Figs. 1 to 5 show the construction of a doll's bedstead. The size will vary according to requirements; any kind of wood may be used. The posts and rails can be jointed by stub tenons and mortises as shown at Fig. 4, then glued together; they may also be further secured by round-headed screws. The head- and foot-boards may be housed into the posts a little distance as shown at Fig. 5. This design, carried out on a larger scale, would make a neat little bedstead for a child. Fig. 1 is a general view, Fig. 2 a side elevation, and Fig. 3 is an end elevation showing the head. Figs. 4 and 5 show joints, as has been said.

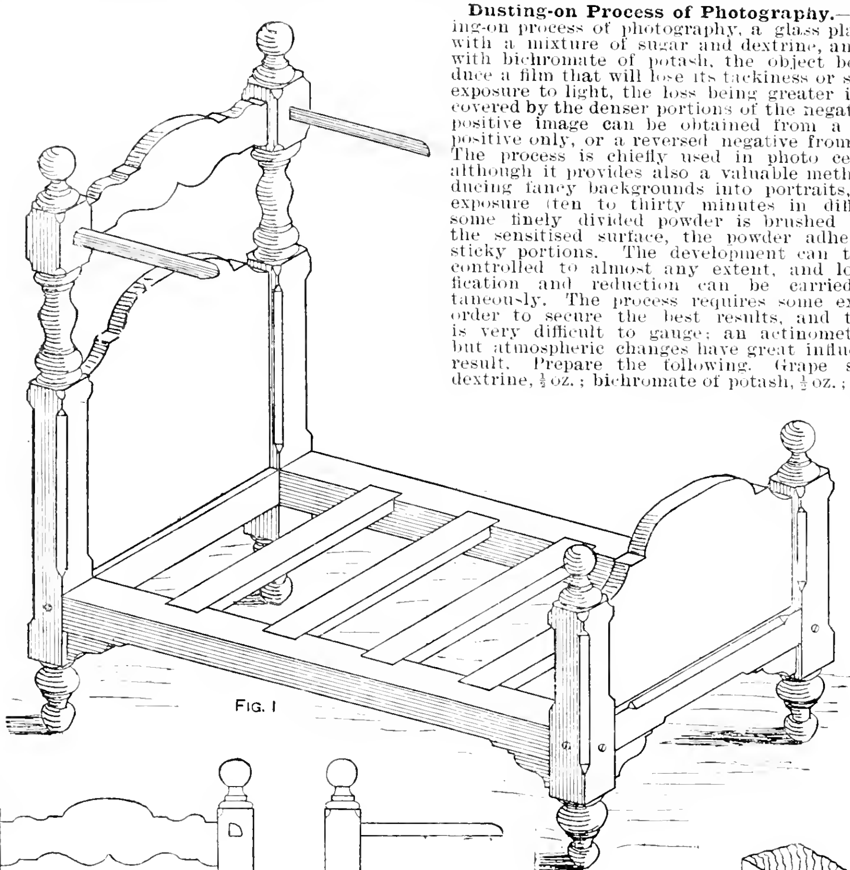


Fig. 1

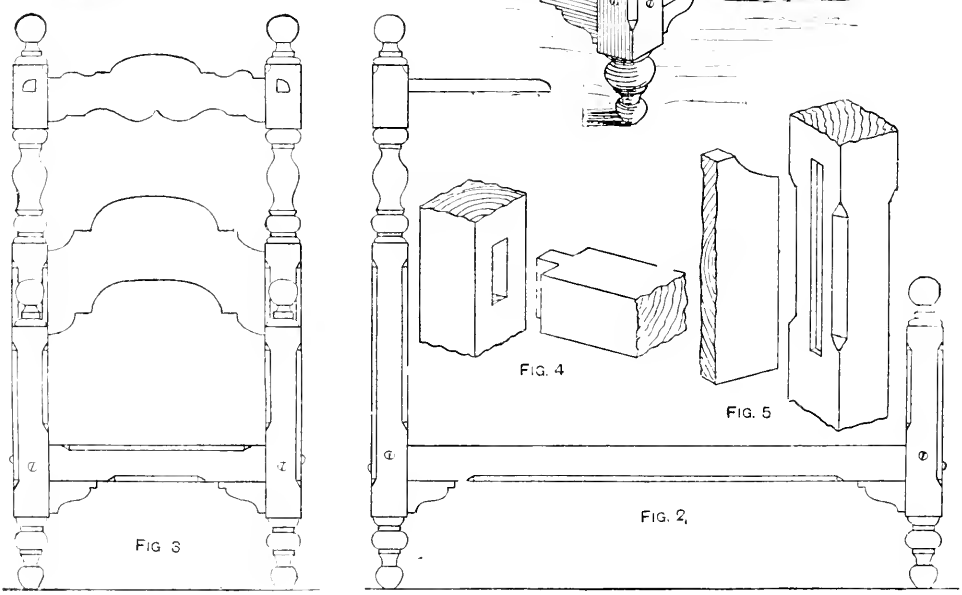


Fig. 3

Fig. 4

Fig. 5

Fig. 2

Design for a Doll's Wooden Bedstead.

Dusting-on Process of Photography.—In the dusting-on process of photography, a glass plate is coated with a mixture of sugar and dextrine, and sensitised with bichromate of potash, the object being to produce a film that will lose its tackiness or stickiness on exposure to light, the loss being greater in the parts covered by the denser portions of the negative. Thus a positive image can be obtained from a transparent positive only, or a reversed negative from a negative. The process is chiefly used in photo ceramic work, although it provides also a valuable method of introducing fancy backgrounds into portraits, etc. After exposure (ten to thirty minutes in diffused light) some finely divided powder is brushed lightly over the sensitised surface, the powder adhering to the sticky portions. The development can therefore be controlled to almost any extent, and local intensification and reduction can be carried on simultaneously. The process requires some experience in order to secure the best results, and the exposure is very difficult to gauge; an actinometer is used, but atmospheric changes have great influence on the result. Prepare the following: Grape sugar, ½ oz.; dextrine, ½ oz.; bichromate of potash, ½ oz.; water, 10 oz. Whilst this solution is filtering, clean some glass plates, coat them, and dry them slowly over a spirit lamp. Expose as above directed, and allow the plate to stand aside and absorb some moisture from the air. Dust over the powder, and coat with collodion as a protective varnish. A good washing in water serves to remove the bichromate salt.

Hollowing Tinplate.—A hollowing block cut preferably from the trunk of an oak or beech tree will be required for hollowing tinplate: a convenient size will be about 3ft. high and 2ft. 6in. in diameter. The holes on the top end are cut in varying depths and diameters with a small adze. If a variety of hollowed articles is to be worked, a set of block hammers will be required. These comprise a bullet-faced hammer for covers; a hammer with the faces curved to a greater radius than the first named for kettle bodies and similar work; and one with the faces flatter than either of the two former ones for canister bodies, etc. When working the metal, if a circle is to be hollowed, place the metal so that the edge of the circle is over a hole in the block of suitable depth, and then hollow it by delivering regularly with the hammer a series of blows first round the edge, and then in a series of concentric circles as far in towards the centre as may be desired. The work is then smoothed by again going over the hollowed part with light regular blows, or giving a series of radial strokes upon a planishing wheel. When hollowing ovals, such as a kettle top, the sides of the oval do not require so much hammering as the ends. If the shape is a rectangle, or an oblong with round corners, the corners are the parts that require most working. Hollowed work in tinplate is usually executed in "tacks" of four or six discs or ovals, according to the thickness of metal used.

Stephenson's Thermometer Screen.—The sketch shows a Stephenson's thermometer screen, which consists of a box, either square or oblong, raised 4ft.

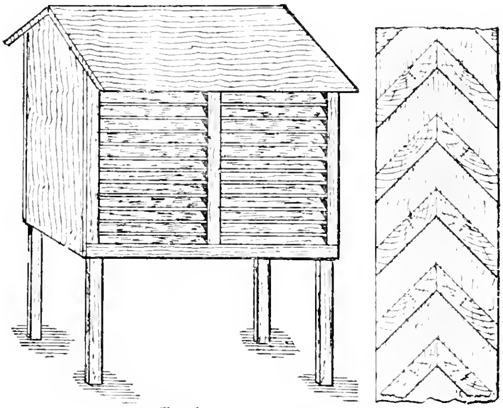


FIG 1 FIG 2

Stephenson's Thermometer Screen.

from the ground. The box may have louvred sides, that is, the sides may be made in a similar way to wooden shutters for windows, thus allowing air to penetrate, but keeping out the direct rays of the sun. But it is preferable to have the louvred sides double, as illustrated in section by Fig. 2, and not single louvred. In strong winds, direct draught on the damp cotton surrounding the hygrometer wet bulb would produce undue evaporation, and give a lower temperature than would be given by the same thermometer when standing in still air of the same temperature. The double louvre minimises the risk of direct draught, and keeps the enclosed air as still as possible. The box is open below and has a wood partition through the middle upon which the thermometers may be fixed. The roof is sloped, and may be painted or covered with tarred felt. The size of the box is not important; but if it is made smaller than 3ft. by 2½ft. by 2ft., it will be necessary to have a hinged door at each end through which to take the readings of the thermometers.

Principles of Hydraulic Lifts.—Hydraulic lifts are of many forms and sizes, from the small dinner lift to the passenger or luggage elevator. The principles on which they work are very simple, and can be illustrated by a common syringe or squirt. If the nozzle of such an appliance is attached to a cock on a water pipe, a piece of indiarubber tubing will do for making the connection, and the piston or plunger is pushed in as far as it will go before starting. On turning on the water, the piston will be forced outwards, and if stood or held upright a load or weight placed on the top would be raised. The weight of the load it would lift would be in proportion to the pressure of the water in the main and the area of the end of the piston or plunger. If the pressure in the main is say 50lb. per square inch, and the end of the piston an area of 1 sq. in., then 50 lb. of weight could be balanced. If one-third of the power is absorbed by the friction between the cylinder and the packing or gland, then $\frac{50 \times 2}{3} = 33 \cdot 3$ lb. equals the load that would be raised, the load including the weight of the piston and carriage, car, or platform upon which the load to be lifted rests. If the area of the above piston end was equal to 100 sq. in., then $\frac{100 \times 50 \times 2}{3} = 3{,}333 \cdot 3$ lb. (which is the load piston, cage, etc.) that would be raised.

Construction of Fireguard.—Fig. 1 shows the fireguard complete as it would stand round the fireplace. It should be of a size to fit against the centre of the mantelpiece jambs, and should stand about 30 in. high, though the height may be varied according to the position. The top rail should be of flat iron ¾ in. wide by ¼ in. thick, and the bottom bar 1 in. by ¼ in. These are bent as shown in Fig. 1, leaving the ends 12 in. long. This size may be either less or more according to the size of the room. The rails are drilled to receive the standard bars at intervals, leaving 3 in. space between the bars. The bars of round iron ⅜ in

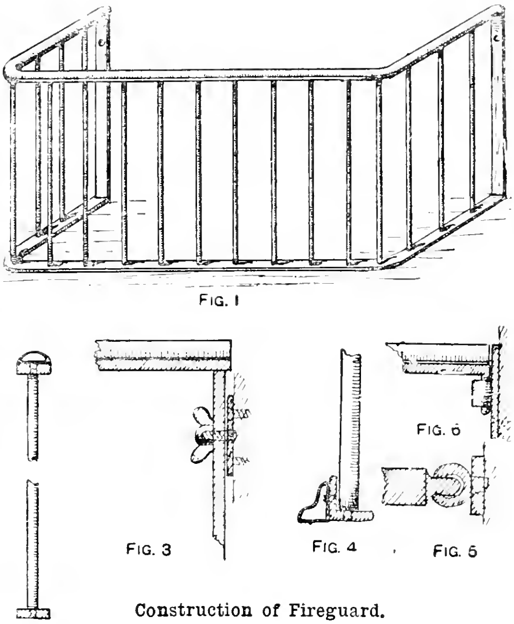


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

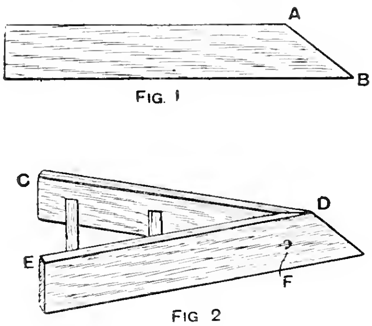
Construction of Fireguard.

in diameter must be reduced at each end and then riveted into the rails (see section, Fig. 2). The back standard bar should be of flat iron 1 in. by ¼ in., with a round hole drilled through at 6 in. from the top to receive the screw on the plate, which is fixed to the mantelpiece, and to which the fireguard is secured by a thumb-nut (see Fig. 3). Another method of securing the guard to the mantelpiece is shown at Figs. 5 and 6. The top rail is turned down to form a hook, which falls into an iron eye on a plate fastened to the mantelpiece. The guard may be made more ornamental by using an angle-iron rail instead of flat iron for the bottom, and fixing on the front a brass ogee moulding (see Fig. 4) and on the top rail a half-round brass moulding (see Figs. 2 and 3). The guard may be painted dead black or any tint of enamel as individual taste may direct.

Repairing Broken Cornice of Ceiling.—If the broken cornice is a fluted one, make a zinc mould of it, using the good part of the cornice as a pattern. Remove all loose plaster, dust with a stiff brush, and well wet the cavity with water. Mix to a proper consistency a sufficient quantity of Keene's plaster, beat it up to a thick paste, and apply with a trowel and sash tool; gradually fashion the cornice by drawing the zinc mould backwards and forwards until the new portion of the cornice lines with the old. If the cornice is an ornamental one, the broken part must be made good by a casting from a mould taken from the unbroken part of the cornice.

Whitening a Discoloured Ceiling.—In whitening an old paper-lined ceiling that has gone a bad colour, clean off the ceiling and remove all loose paper; then apply a coat of size, which may be made by dissolving 6 oz. of glue in 6 pt. of water, and stirring in a handful of plaster-of-Paris. To make a good job, line the ceiling with lining paper and butt the joints; for a strong job, catch-lap the joints. The ceiling may then be whitened in the ordinary way. If the ceiling is a very large one, use Irish moss instead of size with the whiting, as the moss will keep the joints from setting.

An Easily-made Snow Plough.—For the construction of the snow plough here illustrated, two elm slabs about 5 ft. by 10 in. by 1½ in. are required; the planks might be longer and wider with advantage. Cut one end of each plank as at A B (Fig. 1); then place it on the second, and draw a line along A B as a guide by which to cut the second. Place the planks edgeways, as in Fig. 2, and decide the angle at which to fix them. A suitable angle will make the ends C and E 2 ft. 6 in. or 3 ft. apart. Lay E F edgeways on the edge of C D at D at the proper angle, and mark the bevel at D. Then, having fixed C D edgeways, cut down this bevel line with a saw. E F, when placed against this bevel, will now form the angle required, the outer edge being bevelled to a sharp edge. Two strong pieces of wood should then be cut to the length of the cross rails. Place all in position before nailing together, and mark with a pencil the ends of the rails on both planks. Then bore holes from the inside to the marks, and, when all is ready, nail the side pieces together with 3-in. or 4-in. wire nails. Place the rails in position, and nail from the outside through the holes already made. A piece of tin, such as a tin canister flattened out, will, if nailed on the front edge at D, ease the passage through the snow. A strong staple should be placed at each side, as at F, for harnessing a pony or horse to draw the plough. When in use, some heavy logs or a box of stones should be tied on the plough to prevent it rising over the snow.



An Easily-made Snow Plough.

Setting and Preserving Butterflies, etc.—Insects to be preserved in a collection should be killed separately in a wide-mouthed stoppered jar, at the bottom of which is cyanide of potassium covered with plaster-of-Paris. As soon as it is quite dead, remove the insect from the bottle, catching hold of it by the middle—that is, where the legs join the body—and use a pair of tweezers, not fingers or anything as clumsy. Suitable tweezers can be bought at many shops, and can be made by bending double a strip of thin sheet steel or brass ⅜ in. or ½ in. wide and 6 in. or 8 in. long till the two ends meet and form a delicate substitute for forefinger and thumb. The spring of the metal at the bend should keep the ends about ¾ in. or 1 in. apart. The ends can be filed to a blunt point. Touch the insect as little as possible, and always catch hold of it by the thorax. The wings and other parts of butterflies and moths are covered with minute feathers, which are rubbed off and defaced at the slightest touch. The dead insect stiffens and dries up rapidly; therefore, have ready a setting board, on which to hold it in position whilst drying. The setting board is made by gluing two strips of soft, smooth cork, each 9 in. by 1 in. by ½ in., to an under-piece of wood 9 in. by 2¼ in. by ¼ in. The two cork strips are glued to the wood with a ¼-in. groove between their longest edges, and the cork is slightly bevelled off on the outer edge. Insect setting boards used by Continental naturalists are, however, quite flat; but English naturalists consider insects to be spoilt if set flat. Of course, the larger the insect the wider will the board require to be. In the ¼-in. groove the body of the insect lies whilst its wings are extended over the cork on each side. Along the bottom of the central groove glue a strip of cork. Having laid the dead insect in the groove, a pin is pushed vertically through the centre of its thorax down into the cork; the height of the latter should be just sufficient to bring the wing above the edge of the side cork, and packing must be inserted where necessary to ensure this. An entomological pin, long and thin with a small head, is used. If the wings can be spread with a couple of sparrows'-tail or flight feathers fixed in a handle, all the better. Contact with fingers or tweezers or such like spoils the wings. Small slips of letter-writing paper are used as straps to hold the wings in their extended position, a couple or more of ordinary pins being stuck through each strap, but not through the wings. Use plenty of straps to keep the wings extended; put the set insect aside for a week or so, remove the straps, and stick the sample inside a store box or case. Camphor enclosed with the specimens will preserve them from mites, which otherwise might spoil a valuable collection. In the busy insect season many adopt the system of leaving the killed insects to dry unset, so that they may be relaxed and set properly at leisure. Dry insects are easily relaxed by keeping them on damp sand for a few days, when they may be treated on the setting board precisely as if they had but just been killed.

Table for Silvering Plate Glass.—The illustration shows a hot table suitable for use in silvering glass; it has the middle slate removed. One-inch board should be used for the top of the table, the slate top S being 1½ in. thick. The inside should be lined with zinc to make it airtight, the zinc being brought over the side. The slate slab should be bedded in red-lead, all joints being filled with red-lead mixed with varnish. The table must be quite level. A blanket or piece of felt should be placed over the slate when in use, and made wet with water before the steam is used. Steam should be turned on gradually by a valve at I; the hotter the table the quicker the silver will deposit. The outlet pipe O for steam is absolutely necessary, and could be regulated by a valve, as the confined steam would lift off the slate. The outlet pipe should be led to a convenient place so as not to interrupt a clear passage round the table. The pipe W in the bottom of the table is to let out the water formed by the condensing of the steam. The zinc is turned into the groove G, which is also for the bed of red lead. The glass to be silvered must be chemically clean, and whilst still wet from the washing it should be placed on the hot table and have a solution of gelatine or other mordant poured over it. Before this hardens, cover the glass with a saturated solution of nitrate of silver, and allow to remain untouched for about ten minutes. After wiping with a leather squeegee, again apply the silver nitrate solution, and complete the process by a final wiping with the squeegee.

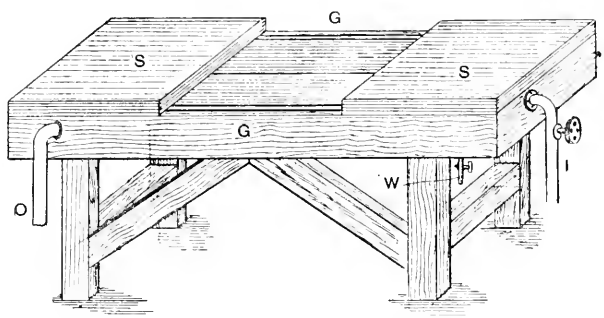
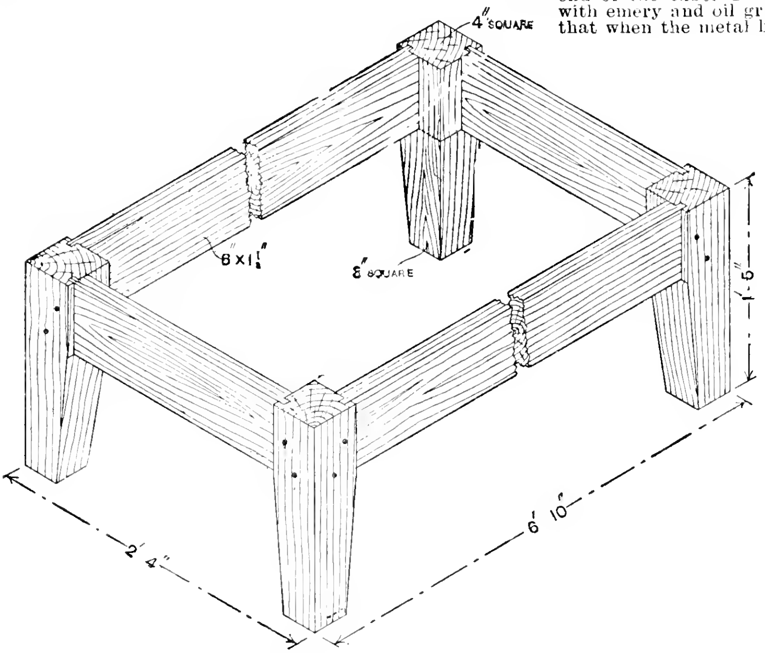


Table for Silvering Plate Glass.

Polishing Cornelian Stones.—Perhaps the best way of polishing cornelian stones in the rough is first to grind them level on a suitable stone, or on a piece of Yorkshire grit obtained from a tombstone cutter. The stone must be kept wet. When a level face is procured, grind out all the markings with emery powder, not too fine; use this on a thick sheet of lead with water. On another sheet of lead grind with a finer emery all marks left by the first emery. Then grind with finest emery on another sheet of lead; by this time there will be a dull polish. When no scratches are visible, polish with putty powder on a piece of felt or leather. Two things must be remembered: Do not stop grinding with one powder until all markings of a previous grinding are removed; and secondly, all the grindings must be wet.

Spinning Copper.—Copper is one of the easiest metals to spin in the lathe, because it is pliable and can be annealed straight off when it becomes hard. The tool must bear on the metal with firmness, but it is best not to take too large feeds, but to mould the metal gradually. It is of great advantage to hold a piece of hardwood against the back of the blank, particularly in the earlier stages. When the blank is first put on the chuck, or after it has been annealed, it feels very soft and yielding, but after a short time it gets harder, and it is not wise to work it too hard. The tool should not be moved from centre to circumference only; that would tend to draw the metal away from the centre and make it thinner there and more liable to break. When the tool has travelled from the centre outwards, let it travel back again to the centre; in this way the metal can be kept of the same thickness throughout. If the blank is fixed to the chuck by a screw through the centre, turn the chuck gradually during the spinning and anneal rather often.

Bier Stand for a Mortuary.—The accompanying sketch shows the construction of the frame of a mortuary bier stand. All the dimensions are clearly marked on the sketch, and when the top is boarded over with 1-in. boards (which should run across the frame), overhanging at the sides and end about an inch, the stand will be complete. The stands may be made of deal, but oak is preferable, though of course more expensive.



Bier Stand for a Mortuary.

Particulars of Microscope Slides.—Some microscope cells are made by painting rings of marine glue upon a slide, and repeating this until the cell is deep enough. Other cells are formed by cementing pieces of plate glass (with the interior removed) to the slides; whilst others, known as "sunk cells," are formed by grinding out a hollow in the slide. Others, again, are known as "tube cells," being formed by cementing a section of round or rectangular glass tube to the slide glass. These may be of any size. There are also "built-up cells," made by cementing separate pieces of glass together.

Making Carbon Paper.—In preparing black carbon paper either of the two following compositions may be used. (*a*) Finest lampblack 5 parts, olive oil 5 parts, cerasin wax 1 part, and petroleum ether 10 parts. (*b*) Lampblack 5 parts, cerasin wax 6 parts, olive oil 5 parts, and petroleum ether 15 parts. The lampblack and oil are ground together in a mortar, transferred to a small dish or pan and slightly heated, and the cerasin wax added; when the latter has thoroughly melted, well stir the mixture, remove it to a safe place, and while still warm add the petroleum ether. For a bluish-black shade, add a little Prussian blue. The mixture, while warm, should be applied with a brush to paper that has been heated in an oven. After the application, lay the carbon paper on an old newspaper and return to the oven to allow the mixture to soak in. After about half an hour's heating any excess of fluid may be removed with a cotton rag; the paper will be fit for use on cooling.

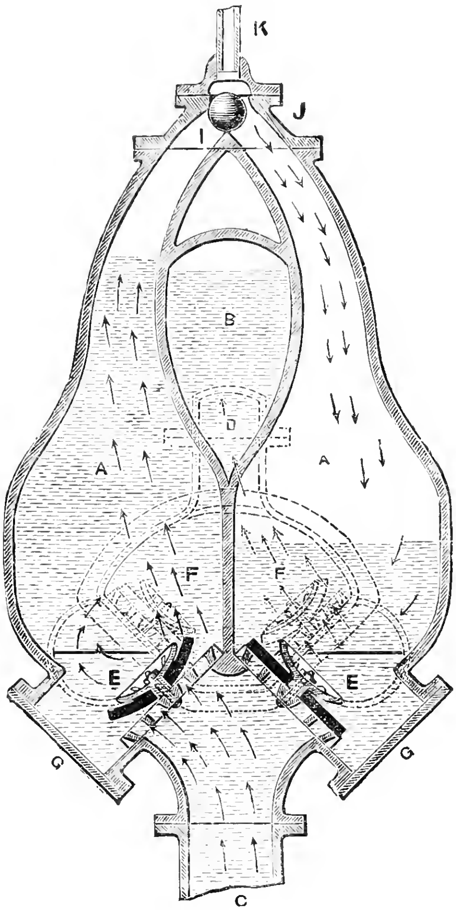
Making Opalines.—In preparing opalines, immerse a photographic print in a 5-per-cent. solution of gelatine. Warm the glass, and pour on it in a pool a portion of the gelatine solution; immediately lay the print, face down, upon this, and squeeze out any air bells. The glasses are generally edged round inside with a rim of gold paint. The prints should be cut slightly smaller than the glasses, and be just large enough to cover the rim. Before the print dries a piece of waterproof paper is mounted over the back. Finally, the strut is affixed with glue.

Air Pump for Blowlamp.—An air pump for a blowlamp, and particularly suitable for the apparatus described on p. 151, may be made from brass tube 1 in. in diameter and 6 in. long. Take a thick circular disc of brass of the same diameter as the tube, and drill a conical opening in the side, and also a cross channel to join it as at D; then braze the drilled disc on the end of the tube. File away the surplus spelter, and with emery and oil grind the conical opening true, so that when the metal ball shown is dropped in it will completely close the passage. If any difficulty is experienced in making the ball fit air-tight, line the cone with thin leather; the ball will then act satisfactorily. C is a plug of leather well soaked in oil, and attached to the plunger rod by means of a small nut as shown. When in use, the back pressure exerted on the lower end of the plug causes it to expand on the down stroke, and so closely fit the tube that all the air in it is forced through the outlet D. On the upward stroke commencing the ball closes down the hole at D, and air passes the sides of the plunger as it is drawn upwards. A screwed cap B made to fit the barrel completes the pump.

Air Pump for Blowlamp.

Cementing Joints Round Cooking Ranges.—A cement that will not crumble and break away from joints in a cooking range and from around the front edges of range covings cannot be obtained. The heat appears to affect the cement, but the real cause is the expansion and contraction of the range parts when heating and cooling. A slow-setting cement might be used, so that when the fire is lighted the range parts and cement may accommodate themselves to each other. If care is taken to keep the joint very small common glaziers' putty could be used; this answers well, as it eventually hardens with the heat. But better still will be to have the stone jambs tight up or overlapping the edges of the covings; or provide a moulded edge up each side and across the top of the range to overlap the jambs and frieze.

The Pulsometer.—The illustration shows a sectional elevation of a pulsometer, which is an appliance for raising water by the alternate pressure and condensation of steam. To describe the parts, K is a pipe from a boiler containing steam under pressure. The gunmetal spherical valve is free to move and to alternately cover the necks I and J. The latter form the upper parts of the chambers A A, into which water passes through the valves E E from the suction pipe F. G G are doors for access to the valves E E for repairs or other attention. Near the bottom ends of A A are side outlets, as shown by the dotted circles, covered by the valves F F, also shown by dotted lines, opening into a chamber with which are connected the air vessel B and the outlet branch D, to which the delivery pipe is attached. The action is as follows. The pump is first charged with water through plug-holes



Sectional Elevation of Pulsometer.

provided for the purpose, and then steam is turned on at K. This presses on the water on the right hand chamber A (which is not covered by the spherical valve), and forces it, as shown by the arrows, through the right-hand valve F and up the delivery pipe. The steam in the right-hand chamber A then condenses, and causes the spherical valve to roll over and cover the neck J, and also creates a vacuum, which is again filled with water through the right-hand valve E from the suction pipe C. When the valve has rolled over J, the steam passes through the open neck I and presses on the water in the left-hand chamber A, forcing it through the dotted left-hand valve F into the delivery chamber. When the left-hand chamber A is nearly empty, the valve is again pulled back by the condensation of the steam in the chamber, which again fills with water during the time the other chamber is being emptied, and these actions continue as long as steam under efficient pressure is supplied. As water will not rise in a vacuum beyond a certain height, a pulsometer should not be fixed more than about 15 ft. or 20 ft. above the water to be raised, although theoretically the limit is a little more than 30 ft. The pump can be slung on chains in a well or sump, so that there is very little trouble in fixing it, or lowering it when necessary for keeping within a working distance of the water. The height to which a pulsometer will raise water depends on the pressure of steam in the boiler, which is used in conjunction with the apparatus.

Making Typewriter Inks.—One of the most popular recipes for ink for typewriter ribbons is as follows. Melt some petrolatum, having a high boiling point, on a water bath. Petrolatum is a soft hydrocarbon obtained from the residues left after the distillation of lighter oils from crude petroleum, or it may be deposited by the latter on standing; its commoner name is vaseline. Incorporate as much lampblack or powdered dropblack as the petrolatum will take up without becoming granular. When the mixture is partly cool, dissolve it, a little at a time, in a mixture of equal parts of petroleum, benzine, and rectified oil of turpentine. Regulate the quantity of the latter solvents to produce a solution of the consistency of fresh oil paint. Try on one end of the ribbon and, if too thin, add wax; if too faint, add colour; if too hard, add vaseline. Apply to the ribbon and brush off the excess. Many typewriter inks have glycerine, a very undesirable ingredient, as the vehicle for the colouring matter. The following recipes are typical of the composition of such inks. (1) Dissolve ¼ oz. of aniline dye in 4 oz. of glycerine, and add 2 oz. of alcohol and 2 oz. of water. (2) Dissolve 1 part (by weight) of powdered aniline dye in 6 parts of glycerine, and add 3 parts of soft soap. Warm until the soap dissolves and well mix. (3) Dissolve ½ oz. of aniline dye in 15 fl. oz. of alcohol, and add 15 fl. oz. of glycerine. (4) A good ink is made by dissolving 1 part of aniline dye (soluble in oil) in 6 or 8 parts of oil of cloves; gentle heat assists the solution. The aniline dye in these four recipes may be of any suitable colour; black and violet are perhaps the most serviceable. Another method of making a black ink is to grind 1 part of gas black with 5 parts of oil of cloves. All inks containing aniline colouring matter and glycerine are copying inks. Two other recipes for copying inks are here given. (1) Grind 1 part (by weight) of suitable aniline colouring matter with 6 parts of glycerine. (2) Dissolve, by the aid of heat, 1 oz. of transparent soap in a mixture of 4 fl. oz. of glycerine and 12 fl. oz. of water; mix with a solution of a sufficient quantity of aniline dye in 24 fl. oz. of alcohol. If the ink is too thin, add soap. The unsatisfactory results given by home-made typewriter inks appear to be caused by the use of glycerine as one of the ingredients, according to Prof. Shuttleworth. The hygroscopic properties of glycerine make it an undesirable ingredient, and the addition of glucose, soap, alcohol, or water does not improve matters. Vaseline, with or without the addition of wax, gives better results, but its consistence is appreciably affected by temperature. Prof. Shuttleworth proposes castor oil as a more suitable medium; the colouring matter may be any of the salts of the aniline series, and of these methyl violet is practically soluble in the oil mentioned. In preparing the ink, triturate the powdered colour with the oil in the mortar, the work being facilitated by the addition of a very little alcohol. A suitable formula for such an ink is that of Higgins. Castor oil, 4 oz.; carbolic acid, 1 oz.; oil of cassia, 1 oz.; suitable aniline colour, 1 oz. Printing inks may be modified for service in the typewriter by adding vaseline to make them non-drying on the ribbon; if it is found that they are too soft, add wax also.

Fog on Photographic Dry Plates.—If light reaches a dry plate by any other way than through the lens when the plate is exposed in the camera, the result is fog; that is, the sensitiveness of the plate is destroyed, and development produces black patches of greater or less intensity according to the amount of light that has accidentally fallen on the plate. This fog may be due to defective slides, to cracks in the camera, to leakages of outside light into the dark room, or to an unsafe lamp. In a score of other ways, all of which may be classed under careless or faulty handling of the plates during their journey from the maker's box to the developing dish, light may reach the sensitive plate and cause fog.

Lead-light Glazing.—As a cement for fixing lead lights to steel frames, the following preparation will probably give satisfaction. Mix liquid glue with a sufficient quantity of wood ashes to form a thick mass; the ashes should be added in small quantities to the glue (while boiling), and constantly stirred. A sort of mastic is then obtained, which, applied hot to the glass and metal, fixes the two firmly together. A good hard stopping can be made of fine litharge, 2 parts; white lead, 1 part; copal varnish, 1 part; boiled linseed oil, 3 parts; the whole is well triturated together. Lead glazing may be fixed in either wood or metal frames.

Making Triad Pictures.—A triad picture is simply three pictures in one; from a standpoint exactly in front of it a certain view, represented by X (Fig. 1), is seen. From a point a little to the right-hand side is seen a totally different view, represented by Y (Fig. 2); while movement to the left discloses a third picture Z (Fig. 3). The construction is very simple. First get three pictures and select the central one. For the purpose of description, suppose it to be 13in. wide; the height is not material at present. On the back of the picture rule pencil lines, dividing it into thirteen divisions, each 1in. wide, and mark these divisions $\frac{X}{1}$, $\frac{X}{2}$, $\frac{X}{3}$, and so on, as shown on Fig. 4. Next take the picture represented by Y (Fig. 2). Suppose it to be 12in. wide; on the back rule pencil lines, dividing it into twelve divisions, and mark the divisions $\frac{Y}{1}$, $\frac{Y}{2}$, $\frac{Y}{3}$, and so on, as shown on Fig. 5. Space the third picture (also 12in. wide) into twelve divisions, and mark each $\frac{Z}{1}$, $\frac{Z}{2}$, $\frac{Z}{3}$, etc., to Fig. 6. Next take a sheet of paper (lining wall paper will do), 37in. long, and in width equal to the height of the pictures. Divide it into thirty-seven parts, and mark each $\frac{A}{1}$, $\frac{A}{2}$, $\frac{A}{3}$, etc. (Fig. 7). Now, with a very sharp knife cut off the central picture the slip marked $\frac{X}{1}$ (Fig. 4), and paste it on the division marked $\frac{A}{1}$ (Fig. 7). Next take the Z or left-hand picture and cut off the slip marked $\frac{Z}{1}$ (Fig. 6), and paste it on $\frac{A}{2}$ (Fig. 7). Then off the Y or right-hand picture cut the slip $\frac{Y}{1}$ (Fig. 5) and paste it on $\frac{A}{3}$ (Fig. 7). Now return to the X picture, and cut off the slip $\frac{X}{2}$ (Fig. 4) and paste it on $\frac{A}{4}$ (Fig. 7), and so on, until all the slips are pasted in the order shown on Fig. 8. Now fold the combined picture on a piece of millboard slightly larger than the central picture, paste down the first strip X^1 (Fig. 8), paste Z^1 and Y^1 back to back, secure X^2 close to the first strip, put Z^2 and Y^2 back to back, and so on (see Fig. 9). If the pictures are comparatively narrow, say 9in. or less from top to bottom, do not cut

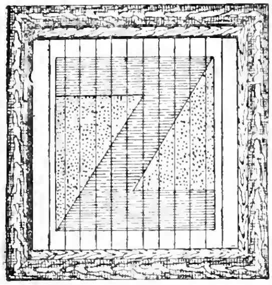


Fig. 3

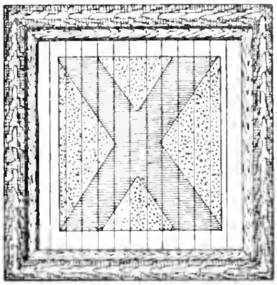


Fig. 1

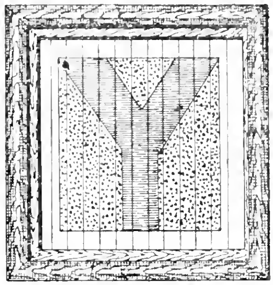


Fig. 2

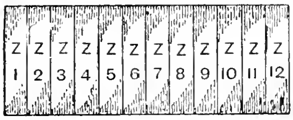


Fig. 6

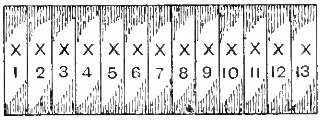


Fig. 4

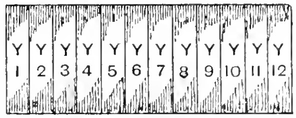


Fig. 5

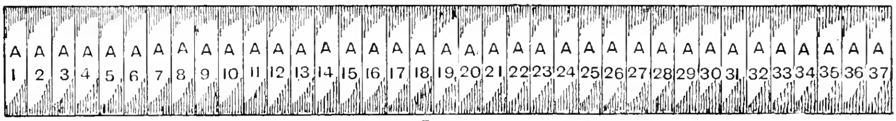


Fig. 7

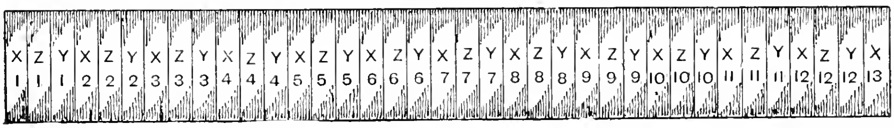


Fig. 8

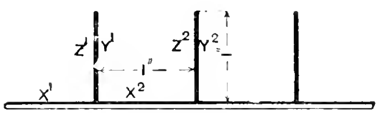


Fig 9

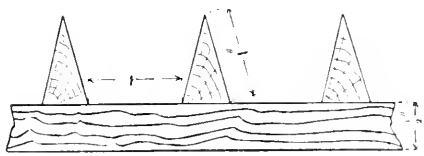


Fig 10

Making Triad Pictures.

the centre one but paste it on a sheet of card, which should be 1 in. larger all round than the picture. Now glue a 1-in. by 1-in. wood slip, neatly mitred at the angles, round the edges of a sheet of stout millboard, make saw cuts ½ in. long and 1 in. apart in the top and bottom pieces, and fix the frame round the picture. Paste the other pictures on paper having ½-in. margins at the top and bottom. Cut them into 1-in. strips, paste corresponding strips back to back, run the brush along the proper edge of the connected strips, and fix the ends into the ½-in. saw cuts. If the centre picture is wider than the others, the height of the upstanding strips will be less than the width of the centre picture strips; when uprights and flat strips are of equal width, as in Fig. 9, shadows are apt to interrupt the side views. Spaces as X[1] in Fig. 9, 1 in. wide, with uprights Y[2] ¾ in. high, will suit a centre picture 15 in. wide, and two others 10½ in. wide, or one 10 in. wide, two 6¾ in. wide, etc.; dimensions respectively of 1 in. and ½ in. suit a centre picture 15 in., and two other 7 in.; and dimensions of ¾ in. and ½ in. suit a centre picture 12 in., and two others 7½ in. Oleographs and photographic enlargements make good triad pictures. Triad signboards having worded announcements are made as in the section (Fig. 10) with wedge-shaped pieces having 1-in. sides and ½-in. base. Paint these same as ground, and put a letter in each division.

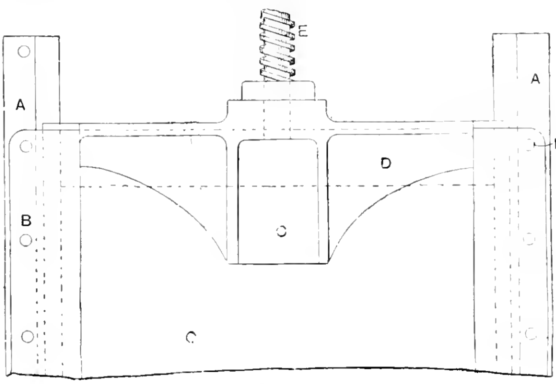
The Manufacture of Artificial Gems.—As early as 1837 Gaudin made artificial rubies by heating ammonia, alumina, and potash by means of an oxy-hydrogen blowpipe; the intense heat volatilised the potash and alumina, afterwards producing crystals in rhombohedral forms identical with those of the natural stone, and having the same specific gravity and hardness. Methods of producing crystals of corundum, ruby, sapphire, etc., were discovered about 1858, but both these and Gaudin's processes had but little commercial value, the great expense precluding their adoption. Until quite recently, the only artificial gems known to commerce were coloured glass, and, in some cases, wax preparations backed with silver or a mercury amalgam. Now, however, the chemist can produce imitations that, in lustre and hardness, equal the real or found gems; perhaps "imitation" is not the correct word, as the composition of both manufactured and found stones is supposed to be the same. Sometimes it is quite impossible to distinguish between the two kinds of gems, although generally examination under the microscope discloses some difference. As seen through a microscope, natural rubies contain minute cracks which indicate the lines of cleavage; the artificial gem shows very minute bubbles or gas holes. Analysis has proved that the sapphire is pure alumina, that is, oxide of aluminium (Al_2O_3). This is found in the form of a white powder fusible at high temperatures only. The colour of a sapphire is supposed to be due to the presence of chrome, and is dichroitic, that is, it varies with the point of observation; thus it is successfully imitated only with difficulty. M. Sidot, the French chemist, accidentally discovered a method of producing gems that possessed dichroitic properties. His method is to heat an iron pot to dark red and to place in it 4 oz. of superphosphate of lime; this is brought to the same heat and stirred with an iron rod, being then converted to crystallised pyrophosphate, which, on being further heated, becomes a fluid resembling molten glass. It is supposed that in this state a part of the phosphoric acid is changed to a tribasic phosphate. The fused mass is stirred continuously until it is quite transparent and free from bubbles, when it is transferred to another pot and kept at a white heat for two hours, the stirring being kept up all the time. After standing for an hour, it is poured on to a metallic surface and allowed to cool slowly until as soft as putty, when it is put on plate glass. When cold, a number of stones almost equal to the genuine sapphire may be cut from the plate. Another formula is: Smelt a mixture of 4 oz. of oxide of aluminium and 4 oz. of red lead (Pb_3O_4), and stir in 10 gr. of bichromate of potassium ($K_2Cr_2O_7$) and 17 gr. of oxide of cobaltum (CoO). When cold, stones may be cut that are as hard, if not quite so brilliant, as the genuine ones. The ruby, also, is oxide of aluminium coloured by chrome. Crystals of the rose-coloured ruby may be produced by melting together aluminium oxide and powdered silica, with the addition of fluoride of barium to form a flux, and then adding a trace of bichromate of potassium; 500 lb. of these ingredients, after perhaps a week's fusion, will produce rubies of 5 or 6 carats which may vary much in colour, running through all the shades of bluish sapphire and rose to the deep colour of the so-called pigeon-blood ruby. Ordinary borax fused with a little chromium oxide for a week or so produces large ruby crystals; but 200 lb. of ingredients may be required to obtain even two or three gems of any marketable value. One method of making artificial rubies is to smelt a mixture of 4 oz. of oxide of aluminium and 4 oz. of red lead, and add from 7 gr. to 16 gr. of bichromate of potassium. Natural emeralds are a combination of the rare element beryllium or glucinum with silicon; chrome gives the colour. Beryllium is too expensive for use in producing imitations, so oxide of aluminium is used, 4 oz. of this being smelted with 4 oz. of red lead, to which from 8 gr. to 12 gr. of uranate of sodium ($Na_2U_2O_7$) have been added. Hautefeuille & Perry, the French chemists, produce some beautiful emerald crystals by fusing silica, alumina, glucina, and a trace of chromium oxide with acid molybdate of lithia. After a fusion of fifteen days some very small crystals, having all the mineralogical and physical characters of the natural emerald, may be obtained. The longer the fusion the larger are the crystals. Emeralds and other gems have been produced from gas retort refuse by a method discovered by Mr. Greville Williams, F.R.S., who modelled an emerald composed of from 67 to 68 per cent. of silica, 15 to 18 per cent. of alumina, 12 to 14 per cent. of glucina, and traces of magnesia, carbon, and carbonate of lime. The colour was an intense green, due, it is believed, to the presence of sesquioxide of chromium. Imitations of the amethyst, topaz, etc., have been made very successfully by Donault Wieland, of Paris, whose method of preparing "Parisian diamonds" or "Alaska diamonds" is to smelt a mixture of 65 per cent. of pulverised crystal quartz, 20 per cent. of red lead, 8 per cent. of pure carbonate of potash, 5 per cent. of boric acid, and 2 per cent. of white arsenic. The brilliancy of the resultant stone depends principally on the purity of the red lead and of the carbonate of soda.

Principles of Sewing Machines.—The principle of the lockstitch sewing machine is, roughly speaking, as follows. The needle descends to the bottom of its stroke, and simultaneously the shuttle slides, vibrates, or oscillates as far as the end of its backward movement. Continuing the movement of the balance wheel, the needle begins to rise, and the shuttle immediately after begins to move forward. As the needle rises the material through which it is passing holds the needle cotton long enough to cause it to loop out behind the eye of the needle under the needle-plate. The shuttle, still moving forward, enters this loop and passes through it, the necessary amount of slack cotton being supplied either by the "time" of the needle-bar or by the check or take-up lever, according to the style of the machine. By the "time" of the needle-bar is meant the movement which is caused by a cam on the bar, causing it to descend the second time after it has risen sufficiently to throw out its loop and to allow the shuttle point to enter it. This descent throws off enough slack cotton to pass over the body of the shuttle without causing any strain on the cotton, and as soon as the shuttle has passed through the loop the needle-bar rises to its highest point and draws up the cotton into the material being sewn and the bottom or shuttle cotton with it, completing its stitch. Under the material and under the needle-plate is a feed dog which rises just before the needle has reached its highest point, and, moving back, carries the material with it the required distance and sinks below the needle-plate before the needle enters the work again. If the machine is a rotary hook machine, the hook, instead of sliding or oscillating backwards, continues to revolve, and is so arranged that when the needle is at the lowest part of its movement, the point of the hook is a little behind it, generally about $\frac{1}{16}$ in., a little more or less according to the style of the machine. The main points to remember are: (*a*) Short groove of needle is always toward the shuttle or hook. (*b*) When the needle is rising and the point of the shuttle is just level with it, the eye of the needle must be $\frac{1}{16}$ in. or more below the shuttle point. (*c*) The shuttle must not start to come forward before the needle begins to rise. (*d*) The feed must carry the material while the needle is well out of the work. (*e*) See that the shuttle point is sharp, and that the shuttle driver wherever it touches the shuttle is perfectly smooth, and that all points over which the cotton runs are also smooth. The movements of chainstitch machines are similar generally to the rotary hook lockstitch machine, but the hook having picked up the needle cotton does not drop or allow it to slip off until it has picked the second needle loop. It is very essential in chainstitch machines to have the right make of needles, as poor needles cause endless trouble. The short groove of the needle is again nearest the hook, and the hook should pass as near the needle as possible without touching. See that the hook is perfectly smooth, and in putting together such machines do not alter in the slightest the shape of this hook.

Removing Rust Marks from Wood.—In re-painting wooden structures disfigured by the marks caused by iron nails having turned rusty, first rub out the rust marks with sandpaper, getting as much rust as possible off the nail heads; then with a small brush worn down to a stump rub well in around each nail head some good oil varnish. When quite dry, apply the paint. The above method will check the rust to a great extent, but it will still form in the holes against the wood.

Testing Gravel for Gold.—In testing a hard rocky gravel for gold, first finely powder a sample of the gravel, moisten it in a tall cylinder with water, and pass chlorine gas through it, whereby soluble chloride of gold is formed. After treating with chlorine the gravel should be washed with hot water, the solution collected in a dish, boiled to expel the chlorine, and then heated with solution of ferrous sulphate. If gold is present it will separate as a fine brown powder. Another method is to take, say, ¼ lb. of the powdered gravel, mix it with litharge (oxide of lead) and flour or cream of tartar, and heat it in a crucible in a furnace. The litharge is reduced by the flour or cream of tartar forming metallic lead, which melts and, as it passes through the gravel, takes the gold with it to the bottom of the crucible. After heating, the crucible is broken open and the button of metallic lead is removed. It is first roasted in a dish in a muffle furnace to get rid of the greater portion of the lead as oxide; the oxidation is then finished on a bone-ash cupel, which absorbs the oxide of lead formed, leaving, at the end of the operation, a button of metallic gold, providing that metal was present in the gravel.

Water-tight Sliding Door.—The opening to which a sliding water-tight door is to be fitted in a ship should have an angle frame all round at the edges of the plate to stiffen up the plating. This angle is on the side of the plate opposite the door. The sketch shows the general construction of a sliding watertight door at the end which takes the screw for sliding the door open. A and D are the sides and top of the cast-iron frame which forms the



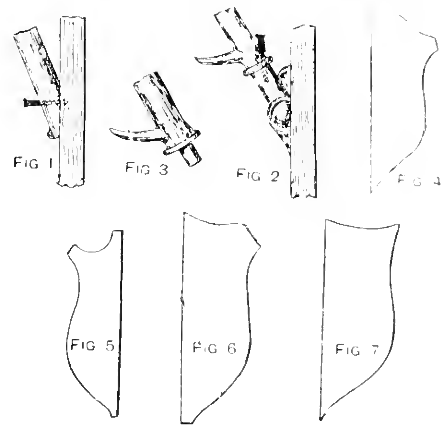
Water-tight Sliding Door.

bed for the door to slide on. B shows pieces of plate, generally about 3 in. broad, which form the back sliding surface. The door itself (C) is a casting. Across the centre and bottom of this is a web, as well as that shown at the top. These webs are solely for stiffening the door. A hole is made through at the centre to allow the door to travel up the screw when the door is being opened. The centre of the screw is usually kept about 6 in. from the bulkhead, and it and the gearing rods are supported by cast-iron brackets. When the gearing has to be angled, bevel wheels are used about 6 in. in diameter, with thirty teeth of ⅗-in. pitch. The gearing rods are usually about 1¾ in. in diameter.

Proportions for a Compensation Pendulum.—A zinc and steel compensation pendulum for a regulator clock having a dead-beat escapement is of fairly simple construction. For a seconds pendulum the central rod is of steel, 5/16 in. thick, and measures 45 in. from the bottom of the thread for the rating nut to the point of suspension. Over this rod, and resting on the rating nut, is a zinc tube 26 in. long and from ⅛ in. to 3/16 in. thick. This tube slides freely over the rod. Outside the zinc tube, and depending from its top end, is an outer steel tube (bicycle tube) 23 in. long. At its lower end an outside collar is fixed, on which the bob rests. This is of lead, cast with a central hole having a shoulder in its centre. The upper part of the hole just frees the steel tube, and the shoulder rests on the collar. The lower part of the hole is large enough to clear the collar. Thus the bob is supported at its centre and expands as much up as down. Its length is 9 in. and its shape cylindrical. For a 14-lb. bob 2¼ in. diameter will be suitable; for a 17-lb. bob 2½ in. will do.

Laying Tar Footpaths.—Tar footpaths are inexpensive as compared with flagging, etc., and if properly laid, water will not soak into them, nor will the heat of the sun melt the tar. It is laid in two layers—the bottoming and the topping. The bottoming, which is composed of slag, clinkers, etc., is mixed with a hot composition of gas-tar boiled in a cauldron, a little pitch and resin being added. Before being used, the materials must be allowed time to become thoroughly incorporated with the tar. The formation level being ready, a thickness of 2 in. of this bottoming is laid and well rolled. The top layer, 1 in. in thickness, is now laid on this and well rolled. The topping differs from the bottoming only in the smaller and finer quality of the materials which, in the case of topping, are mixed with the tar. The surface is now flooded with the tar composition in a boiling condition, and, whilst wet, is blinded with clean white sand or fine granite dust. A footpath of this kind lasts a long time without requiring any repairs worth mentioning. Inequalities and bad patches must be cut out as soon as they occur, and new material well rammed in. Every two or three years, according to the character and extent of the traffic, a fresh top should be laid over and blinded. These footpaths will, however, last usually six or seven years without requiring absolute renewal.

Cleaning and Mounting Antlers.—Below are given instructions on cleaning and mounting a pair of stag's antlers. Well wash and scrub the antlers with warm water and soap. Thoroughly dry them with a cloth or towel, then give another smart rubbing with a perfectly dry cloth to remove some of the dulness from the sharp edges



Cleaning and Mounting Antlers.

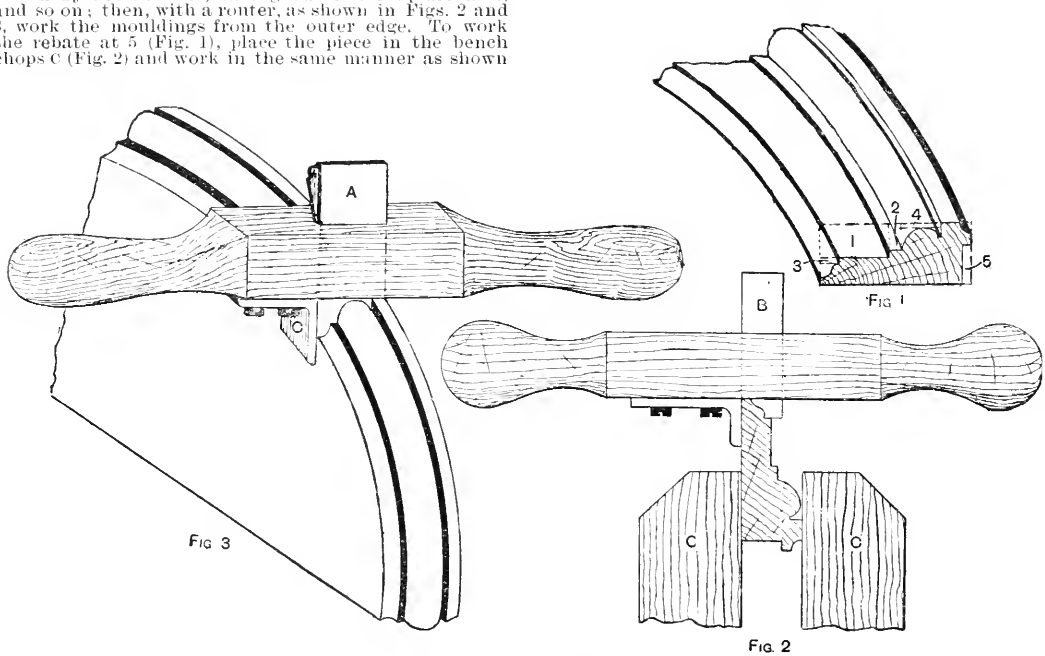
and prominences. The antlers can be mounted by one of the following methods. Fig. 1 shows how, by cutting a piece off the back of the antler, it may be fixed to the mount by means of a screw passing through a hole previously drilled in the antler. Fig. 2 shows an artificial forehead of wood, with short processes or projections upon which the antlers rest, being screwed from the back. Another method is to drill a large hole lengthwise into the antler from the base, and in this hole to place a dowel (see Fig. 3), by means of which the antler may be fixed as in Figs. 1 or 2. Designs of shields or mounts are shown by Figs. 4 to 7. To make these, double a piece of paper, draw half the shield as shown, and cut out through both pieces of paper. Flatten out the paper and mark round on the wood with a pencil. The mounts can be made of oak, mahogany, or walnut, the first-named for preference. Ebony or ebonised wood is rather too gloomy, though often used.

Gilding Steel Pins.—Highly polished steel pins, free from grease and oil, may be gilded in an electro-gilding solution of gold cyanide. When a quantity of pins is required, they may be gilded in dozens at a time if suspended in the solution in a basket of platinum gauze, which must be shaken whilst the gilding process is going on. Any gold deposited on the platinum may be afterwards dissolved off in the gilding solution without doing it any injury. The pins are scratch-brushed and polished in the usual manner. This method is applicable to all small steel articles.

Varnish for Walnut Gunstock.—A walnut gunstock may be coated with a very bright varnish made according to the following recipe. Take 1 oz. of best orange shellac, 1 oz. of gum sandarach, 2 oz. of gum benzoin, 1 oz. of Venice turpentine, one pennyworth of camphor, and 1 pt. of methylated spirit frequently agitate, and carefully strain through muslin. The varnish should be applied with a camel-hair brush in a warm room.

How to Make Photographic Silhouettes.—In making photographic silhouettes, as the exposure required is so much less than that necessary for an ordinary portrait, a slow lens can be used. Stretch a sheet across an open doorway where it can be well illuminated from without, and set the camera up in the room, the figure being close against the sheet. Remove from the room any articles likely to throw light on the figure, which should be dressed in black, and focus the dark outline shown on the sheet. A brief exposure must be given, as it is necessary to expose for the sheet only; backed plates must be used to prevent halation, that is, a spreading of light around the edges of the shadow due to the light reflected from the back of the dry plate. Magnesium light is particularly suitable for this work. When the feet are to be included, the figure must be supported upon plate glass covered with thin muslin.

Working Circular Mouldings.—Fig. 1 shows a piece of circular moulding worked on the flat surface. First cut out the required shape or plan; get the piece equal in thickness and parallel in width. Sink squares as shown by dotted lines, taking out No. 1 square first, and so on; then, with a router, as shown in Figs. 2 and 3, work the mouldings from the outer edge. To work the rebate at 5 (Fig. 1), place the piece in the bench chops C (Fig. 2) and work in the same manner as shown for the small member on the inner edge. Fig. 3 shows how the moulding may be worked on the edge of a shelf bracket. The router can be bought at a toolshop, or made with a piece of hardwood and a piece of $\frac{1}{16}$-in. thick steel. B (Fig. 2) and A (Fig. 3) show the cutter. The fence C (Fig. 3) may be either of brass or iron slotted so as to be adjusted.



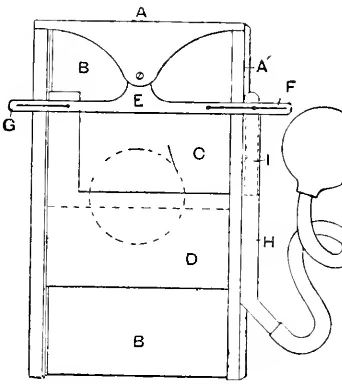
Working Circular Mouldings.

Preparation of Skins for Glove Making.—"Kid" gloves are made chiefly from lamb and kid skins, which have to pass through many processes, such as washing, hairing, paddling, tanning, staking, colouring, and polishing. First the skins, each about 1 ft. long and 3 ft. wide, are soaked for one or two days in cold water contained in wooden vats; the soaking tubs each contain about 600 skins. The latter pass to a circular drum having a horizontal axle, a diameter of about 8 ft., a width of about 1 ft., and making about one revolution per second. Wooden pins projecting into the interior of the drum keep the skins in motion, so that a continuous stream of water thoroughly saturates the skins and frees them from dirt. At the end of fifteen minutes the skins are removed to the lime pits, which may be about 8 ft. long, 5 ft. wide, and 8 ft. deep, and capable of holding many hundreds of skins. The lime and water loosen the hairs, and at the end of a fortnight the skins are taken out with long-handled tongs, and the excess of lime is removed by placing them in cold water and running them backwards and forwards over a paddle wheel, 3 ft. in diameter, 6 ft. long, and making forty revolutions per minute. After this paddling, the skins are spread over an oval-shaped wooden bench, and the hair is scraped off with a tool resembling a carpenter's draw-knife. A similar bench is used in fleshing—the next operation—in which all particles of flesh are cut off, the skin is given an even thickness, and the ragged ends are trimmed. After being washed in the revolving drum for thirty minutes, they are again fleshed to remove the grease, paddled in warm water, spread out on benches, and slated to remove surplus dirt. After again being paddled, the skins are drenched in a tub of bran and water, being paddled in the drench for twelve hours; this removes the last traces of lime and opens the pores preparatory to tanning. The latter operation is performed in a revolving drum, the tanning liquor being a mixture of alum, salt, flour, yolks of eggs, and water. The drum makes eighty revolutions per minute, and at the end of twelve hours the skins are removed and hung up for twenty-four hours in the drying-room, heated to a temperature of 110° F. The dry skins are damped with water and softened in a mill, consisting of two perpendicular swinging planks, having heavy wooden blocks at their lower ends; in front of these blocks the skins are placed and squeezed and pressed together until soft. The next operation is staking, performed by drawing the skins over a knife-edge. After a little time in the drying-room, the skins are again staked, this staking tending to soften the skins and to remove the dried flour left from the tanning. After ripening for a few months, the skins may be dyed, being first washed in a drum of cold water for twenty minutes and then placed for twenty-four hours in a revolving bath of egg-yolk, which softens the skins and makes them pliable. In colouring, the skins are slicked out smooth on a lead-covered table and washed with potassium bichromate and soda. The dye is then poured on and rubbed in with a brush. Iron sulphate is used for black, zinc sulphate for drab, and sulphate of alum for tan. After dyeing and staking, the skins are finished by polishing on a flannel-covered wheel. The tanned skins are made up into gloves as described on p. 286.

Polishing Paste for Brown Boots.—A good polishing paste for brown boots can be made with 20 fluid oz. of good malt vinegar, 10 fluid oz. of filtered water, 2 oz. of good glue, 1 dr. of soft soap, and 1 dr. of isinglass. Colour with annatto or turmeric to the shade required. First mix the water and vinegar, then dissolve the glue in the fluid by gently heating it; add colouring and other ingredients, and boil from ten to fifteen minutes. When the mixture has been strained thoroughly, it is stored in jars until required for use. To use this composition, lay it on with a clean sponge, and polish with a soft rag or flannel.

Tools for Engraving Letters. Generally speaking, the shank or some other portion of a letter is engraved with a flat tool and finished with a lozenge graver whetted at three angles. Block lettering is wholly cut with a flat tool. Old English is cut with two flat tools of different widths, and finished with an angle graver, as above. This is the reason that the work looks regular and of equal size throughout, and is kept straight by working between parallel lines. To make a flat tool for lettering, whet each side of the belly or underside of a lozenge graver at an acute angle, the sharper the better, and then rub away the angle thus formed until a flat is formed of a width suitable for the letters to be cut; then sharpen as from the back as usual. A very moderate set-off or bevel is required for flat work, as if the bevel is too great it will cause the tool to slip over the boundary lines, and consequently spoil the work. Before attempting engraving on articles of value considerable practice should be had on a plate of German silver or sheet brass. For drawing outlines, the only instrument used is the steel tracing point or etching needle.

Construction of Camera Shutter. — A camera shutter similar in working to the unicum is made as follows. Construct a grooved framework A consisting of a board B with an opening for flange and grooved rails A′. Cut two blades in ebonite, C and D. The lever E, with slots F and G, is made in thin metal. Fasten to A′ a cylinder made from a piece of brass tube H, having a well-fitting piston-rod I. (A

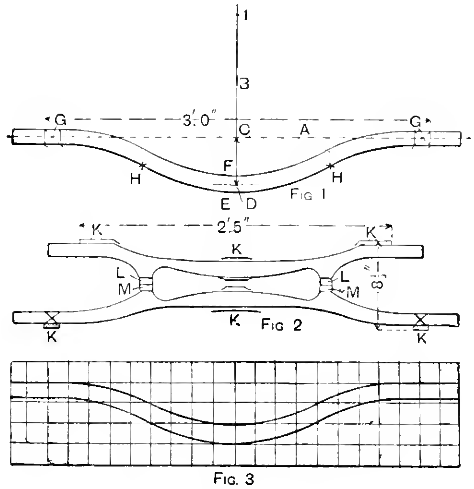


Construction of Camera Shutter.

simple substitute may be made easily by winding some paper tightly around a piece of knitting needle.) Two small rivets, fastened to the blades C and D, pass through the slots F and G, so that when the piston-rod that is attached to E is forced upwards C is raised and D depressed, thus opening the lens. The return of the rod is caused by the suction due to the release of the press ball.

Polishing Painted Furniture.—Before painted furniture can be French polished, the paint must be removed; do this as explained on p. 237. Should the furniture have been finished out with enamel paint or varnish with a spirit basis instead of paint, strong soda water, or a solution of hot borax and rock ammonia, should be used; or, if the lime is objected to, try the following. ¼ lb. of American potash, ¼ lb. of soft soap, ¼ lb. of rock ammonia, 1 lb. of washing soda, and 1 gal. of water. The outer coverings of the upholstering should have been removed before commencing, and they should not be replaced till the polishing is completed. If the furniture is of mahogany, it should now be a dark colour, which only needs wiping over with red oil, made as on p. 11, and a trace of red in the polish to ensure a rich dark mahogany or Chippendale colour. A red colour is imparted to the polish by adding one pennyworth of Bismarck brown to each pint. In French polishing, a pad of wadding enclosed in fine rag is used. Saturate the wadding, cover it with the rag, and draw it up tightly till it presents a face free from creases. The pad should then be applied with continuous, uniform, circular strokes with slight pressure at first, recharging the pad with fresh polish at frequent intervals, taking care that every portion of the wood receives an equal but not excessive body of polish. A few spots of linseed oil should be occasionally applied to the face of the pad to prevent it sticking. If the surface of the furniture is uneven, it is impossible for an inexperienced worker to finish it out perfectly bright with polish only. When the furniture appears uniform in colour, and the grain is filled up, it should be finished by the application of at least two coats of best quality brown hard spirit varnish.

Pattern for Compassed Bed of Under-carriage.—Below is described one way of marking out a pattern for the compassed bed of an under-carriage. As an example, Fig. 1, which represents an ordinary compassed bottom bed of a brougham under carriage, is given. To set it out, draw the straight line A (Fig. 1); square off a line B, and from C mark off the compass F in. to D, which is the centre of the bed. From D, mark off the width of the bed back and front, as E E. At G and G, which are the spring bearings, on each side of the centre line mark off distances equal to the width of the bed; this is governed by the wheel-iron head. Mark off the size of the wheel plate, as at H H, cutting these points by half the width of the compass of the bed; then, using I on the square line as centre, strike a true line to the points D and H H. With the same radius, continue the sweep towards the end until it meets the square line, which should be about 1 in. inside the spring bearing G. With the compasses of the same radius, describe the inner line of the pattern. Fig. 2 shows the elevation of the beds when together, and the method of sweeping them out. The parts K represent the top and bottom bed plates, L the



Setting Out Pattern for Compassed Bed of Under carriage.

wheel plate, and M the transom plate; the beds are left straight in the centre until the top and bottom plates are fitted, these being screwed on temporarily. The beds must be swept out as shown, care being taken to leave intact the bearings for the wheel plate and transom plate. In testing a carriage for truth, the tools used generally are a straightedge, square board, and wax line. If these do not give a sufficiently exact result, draw a diagram as Fig. 3, setting the squares off perfectly true, when any error can be quickly seen.

Jointing Electric Wires.—In jointing up seven-strand electric cables, the insulating covering is removed for several inches from each of the two ends to be joined, and the copper surfaces are scraped absolutely clean. They should be touched as little as possible by the hands to prevent any moisture reaching them. Tinned wire is preferable. Care must be taken that nicks are not made in the strands while the insulator is being removed, since such nicks decrease the sectional area of the wire to a considerable extent. The wires are then taken and opened out, the two sets being placed together and interlinked, the central strand of a seven-strand cable being cut off short to allow this to be done. The ends are then well wrapped round each other, and trimmed over fairly smooth with pliers. Using resin as a flux, and taking care throughout the whole operation that everything is clean, the whole is then well soldered. The insulation on the cable will determine whether strips of pure rubber or of gutta-percha should be then wound round the joint. The latter should be warmed by a spirit-lamp and well kneaded by thumb and fingers. After several layers of this strip have been applied, the whole is wound round with specially prepared tape.

Hints on Choosing a Dwelling-house.—In ascertaining whether a house is a desirable dwelling place, first examine the walls of the house, and if settlements or cracks are discernible, it is more than likely that the foundations are faulty; these should be bared and examined. Renewing or underpinning a foundation is a very expensive operation. When any serious settlement takes place, stone heads of windows show defects as soon as any part of the building. If the external walls of the house are built of rubble stone or brickwork, see that the mortar is of good quality; a simple test is to rub it between the finger and thumb, when, if it crumbles into dust, the work will require to be repointed in a short time to prevent moisture penetrating. If the house is covered with slates, see that zinc soakers are placed against the party walls. If it is covered with tiles, see that cement fillets instead of mortar fillets are used. In the selection of a cottage the sanitary arrangements are the object of most importance. It is essential, before purchasing, to have the drains tested by an expert. Never have a dustbin built against the wall of the house; the contents of the dustbin will saturate the wall and contaminate the air of the interior. The damp course should be in accordance with the requirements expressed on p. 259, and must not be made of tarred felt material. Find out whether a proper circulation of air exists under the ground-floor joists, to prevent dry rot. If there is a drinking-water cistern, see that it does not directly supply a water-closet, and that the overflow from the cistern does not directly connect with the drain. The soil pipe should never be placed inside the house, because if it is defective in its original construction, or if it be subsequently damaged, a serious leakage of foul air takes place. The water-closet should have direct light and ventilation. The long hopper pan should be objected to, because it always becomes filthy. The sink should be in a well-lighted position and always against an external wall. See that none of the rain-water pipes have any connection with the soil pipes. As to the interior, see that the doors fit and are out of winding; observe the framing and see whether the shoulders are off—that would be an indication of unseasoned wood having been used. Look to the hinges; there may be only a screw or two in each hinge. Try the locks and see that the furniture is fixed on securely. Examine the windows to see whether the sashes are too loose; if so, have the rattling remedied.

Repairing Worn Watch Pivot Holes.—It is not necessary to plug and re-drill watch pivot holes when they are worn. Purchase some watch bouchons. These are brass pins, turned true and drilled accurately to centre. Select one that will nearly go on the pivot. Put it in a pin vice, and very slightly file it tapered. Then open out the pivot hole with a broach until the bouchon can be hammered in tight and broken off. File it level with the plate, and smooth off by stoning. Then open it out to fit the pivot. This method leaves the depth unaltered.

Waterproofing Fabrics.—Woven fabrics may be rendered waterproof in a variety of ways, one of the commonest methods being to apply a coating of rubber solution and then to vulcanise the film of rubber remaining after the evaporation of the solvent. By the waterproofing method of Hime & Node, zinc is added to a solution of cellulose in an ammoniacal copper solution; copper is precipitated, and the fabric to be proofed is immersed in the remaining colourless viscid solution of ammonium, zincate, and cellulose. The impregnated fabric is pressed, dried, and wet-calendered, that is, passed between rollers. By another method, a fabric having a close texture is treated with sulphuric acid (115 Tw.), the fibres being partly parchmentised thereby, and the interstices closed without the texture of the cloth being in any way injured. The excess of acid is washed out, with or without previous treatment with alkali, and the fabric is passed between calendering rolls, which complete the closing of the interstices. Holfert's process is to pass the fabric through a bath of gelatine and then expose it to the action of gaseous formaldehyde, the gelatine becoming insoluble. Another method of treatment is to apply to the fabrics boiled linseed oil, paints, varnishes, asphaltum, etc., as in the production of oil-skin, tarpaulin, etc. (see p. 69). But one of the best of the waterproofing processes is explained below, in which the fabric is treated with an alumina soap. The word "soap" refers generally to a material used in removing dirt, and this it does by attacking grease and by removing the harshness or "hardness" of the water in use. But there are soaps which are insoluble in or quite incompatible with water, and these have their use in rendering fabrics waterproof. The ordinary soap of commerce is in one of two classes—"hard" or "soft"—and is formed by boiling fats with alkalis. With soda as the alkali a hard soap results, with potash a soft soap, these products being the alkaline salts of certain fatty acids—oleic, palmitic, stearic, etc.—derived from the fats used. When a solution of the salt of any other metal is added to a solution of either of the above soaps, a precipitate of an insoluble soap of that metal is formed, because all but the alkaline soaps are insoluble in water. In this manner it is possible to produce soaps of lead, copper, iron, aluminium, etc. Alumina soap, so largely used in waterproofing, is formed from alum and soap in the manner above described. In waterproofing fabrics with an alumina soap, one of two different methods may be employed. For the first method two solutions are required. (1) 1 lb. of alum in 1 gal. of boiling water; (2) 1 lb. of ordinary soap in 1 gal. of boiling water. Keep these solutions in separate tubs or troughs. The best soaps to use are palm-oil or white-curd soap, but common yellow soap answers very well. The soap must be dissolved entirely or the coating will be patchy. When the solutions have cooled slightly, but while they are still warm, the cloth to be waterproofed should be immersed in the soap bath for about fifteen minutes, so that the soap sinks into the fibre. The cloth previously should have been soaked in water and wrung out. After wringing out the excess of soap solution, immediately plunge the cloth into the alum bath, in which it may remain for an equal period, and, being removed, excess of alum solution may be wrung out also. If a thick coating of the alumina soap is required, the cloth may be put through this treatment two or three times, and, after steeping in clean water, it may be hung out to dry. The cloth on drying will be rather stiff and white, and somewhat rough, but will be quite waterproof; if the roughness is objected to, pass over the surface a hot iron, or calender the cloth between rollers. Any kind of cloth may be treated by this method, but the most suitable kinds are those that are closely woven, no matter how coarse the fibre is. Fabrics waterproofed in this way are but little altered; their feel is, however, somewhat harsh, and water poured over them will run off without wetting any part, the alumina soap having filled up all the interstices, and formed over the fibres a protective coat, which prevents the water touching the cloth. The second method of applying the alumina soap is in the form of a solution in petroleum ether. The alumina soap is formed by mixing together the boiling alum and soap solutions as previously prepared; for complete precipitation 2½ lb. of soap will be required to every 1 lb. of alum. The alumina soap separates out as a large cake, which should be collected on a piece of cloth, and the water squeezed out. The cake may be broken up into small pieces, thoroughly dried at a low temperature, put into a dry, wide-mouthed bottle, and covered with petroleum spirit (benzoline); paraffin oil is unsuitable, because it forms an unmanageable stringy mass. As the soap absorbs the benzoline it swells and should be stirred from time to time so that it is mixed thoroughly. The paste thus formed may be diluted as required with benzoline, but care should be taken not to add too much of it at any one time, because on standing the mass becomes unaccountably fluid, and possibly too thin; if this should occur, a little of the alumina soap is added. The waterproofing solution made in this manner may be laid on the cloth with a brush or, better, by passing the material through rollers fed with the solution. After treatment, the cloth should be hung out for a short time in the open air to allow the benzoline to evaporate. If a thicker dressing is required, the cloth may be coated two or three times; for ordinary purposes, however, once is quite enough. The alumina soap may be coloured reddish-brown by the addition of a little perchloride of iron in place of some of the alum, and green by the addition of sulphate of copper (blue vitriol). It is also possible to obtain other colours by employing solutions of other metals, but these are more or less expensive. The common colours, yellow and black, may be imparted by stirring in yellow ochre or lampblack with the soap solution in the first method, or by kneading it with the alumina soap in the second.

Carrying Camera on Cycle.—The best way of carrying a camera on a cycle is a much-debated question. The slides may be carried knapsack fashion on the back of the rider, the stand across the top bar of the frame, and the camera slung in a case over the back wheel. On a long journey, however, it is uncomfortable to carry anything on the back. If the apparatus is carried on the handle-bar the vibration is very great, and shutters, etc., soon get out of order; dust also readily accumulates. The dust trouble, however, may be easily overcome by carrying the camera and slides in dust-proof or close-fitting cases, and where the springs in the dark slides do not keep the plates tightly in position, a piece of rubber tubing put between one of the plates and the backing card will often overcome any vibration. But anything bulky on the handle-bar is liable to affect the steering, and increases the danger of side slip, while anything carried within the frame of the machine may make the pedalling very uncomfortable.

Killing Butterflies.—To kill, pinch them under the wings between the finger and thumb, or, for a collection, procure a "killing bottle," which may be bought from most naturalists, or may be home-made. Get a wide-mouthed bottle, provided with a good cork or glass stopper, and into this put an ounce (for a 4-oz. bottle) of cyanide of potassium in lumps. Then mix up some plaster-of-Paris, and pour this upon the cyanide, so as to cover it completely. Give the bottle a shake as the plaster is setting, so that it forms an even surface, and, when quite set, cover the plaster with a piece of blotting-paper to absorb the moisture and to keep the insect from contact with the damp plaster. This blotting-paper should be renewed when necessary. The cyanide is a deadly poison, so must be used with care, and the bottle kept corked. Put the insect into the bottle, cork it up, and leave the insect in for about ten or fifteen minutes. A few drops of strong spirit of ammonia poured on a piece of cotton-wool in a bottle will also form a killing bottle. Bruised laurel leaves may also be put into a bottle, and prussic acid will be given off, thus forming another killing bottle. A few drops of chloroform poured upon blotting-paper at the bottom of a bottle will also stupefy the insects to death. Nothing is required to preserve butterflies.

British Association Screw-threads.—The following table gives particulars of the Swiss small screw gauge as adopted by the British Association:—

No.	*Diameter (approximate) in Inches.*	*Pitch in Inches.*	*Diameter in Millimetres.*	*Pitch in Millimetres.*	*Threads per Inch.*
25	·01	·0028	·25	·072	353
24	·011	·0031	·29	·08	317
23	·013	·0035	·33	·089	285
22	·015	·0039	·37	·098	259
21	·017	·0043	·42	·11	231
20	·019	·0047	·48	·12	212
19	·021	·0055	·54	·14	181
18	·024	·0059	·62	·15	169
17	·027	·0067	·7	·17	149
16	·031	·0075	·79	·19	134
15	·035	·0083	·9	·21	121
14	·039	·0091	1	·23	110
13	·044	·0098	1·2	·25	101
12	·051	·011	1·3	·28	90·7
11	·059	·0122	1·5	·31	81·9
10	·067	·0138	1·7	·35	72·6
9	·075	·0154	1·9	·39	65·1
8	·086	·0169	2·2	·43	59·1
7	·098	·0189	2·5	·48	52·9
6	·11	·0209	2·8	·53	47·9
5	·126	·0232	3·2	·59	43
4	·142	·026	3·6	·66	38·5
3	·161	·0287	4·1	·73	34·8
2	·185	·0319	4·7	·81	31·4
1	·209	·0354	5·3	·9	28·2
0	·236	·0394	6	1	25·4

Double-action Harp.—The action is complicated, and unless it works with the greatest accuracy it is worse than useless. Briefly, the principle consists in placing beneath the wrest-pin a small collar having two studs fastened on its "flat" similar to a "wing-nut," the whole working on a stud through the head. These are connected by a system of levers in head and pillar to the pedals, pressure upon which causes a partial revolution of these collars, between the studs of which the string passes, and is consequently tightened or raised in pitch. Various pedals are required; for instance, one for F sharps, another for C sharps, and so on, each pedal affecting only the notes of the same name throughout the instrument.

Laying Red Tar-paving.—A very dull red tint may be obtained by using crushed red granite instead of limestone. The objection is that each particle of granite has a smooth surface, and the tar does not adhere satisfactorily. The cost will be from 1s. 10d. to 2s. 3d. per superficial yard. Another method is to dye the limestone with red oxide of iron ground very fine. The ordinary method of laying may be adopted, and the cost will be from 1s. 6d. to 2s. per square yard.

Toughening Paper.—Soak ordinary unsized paper in sulphuric acid (2 parts of acid to 1 part of water) for a few minutes, then thoroughly wash it with water containing a little ammonia until no trace of acid remains, and let it dry. This is "parchment" paper, and it is not much less pliable than the untreated kind.

Straightening Warped Fretwork.—The warping or twisting of fretwork is ofttimes counteracted by the use of three-ply wood—that is, three pieces of very thin board or veneer glued together, the middle one being transverse to the others. Warping is often caused by excessive polish being applied to one side only, without a coat of varnish on the back to counteract. Nothing can afterwards be done, except to take the brackets apart and slightly damp them with clean water; screw them down between two stout boards till straight, then apply polish or varnish on both sides. There will still be the tendency to twist back again if the brackets are put in a hot place.

Bending and Fitting Ribs for Small Boat.—Use straight-grained American elm or oak, the former for preference. After being shaped and dressed, the ribs are steamed or soaked in boiling water till pliable, and bent over the knee where necessary. The ribs on either side are notched to fit over the keelson, and butt against each other where they cannot be carried right across. The keelson must not be cut: the ribs are usually spaced closer in the bow to add strength. Floor ribs extending on either side of the keelson and between the others are also notched and fitted over the keelson. A fore and aft stringer on either side is then screwed to both sets of ribs, which bind the whole together.

Cementing Felt to Iron Rollers.—To make a cement, cover glue with moderately strong acetic acid instead of with water, and treat it as for ordinary glue. Another cement is made by dissolving 2 parts of shellac and 1 part of Venice turpentine in 7 parts of methylated spirit. For a firm hold the cylinders should not be quite smooth.

Electric Current Carrying Capacities of Copper Wires.—The following table is based on a current density of 1,000 ampères per square inch; the loss will then be 2 volts for 80 yd.:—

No. S.W.G.	*Diameter in Inches.*	*Area in Square Inches.*	*Current in Ampères.*
22	·028	·0006	·6
20	·036	·0010	1
19	·040	·0012	1·2
18	·048	·0018	1·8
17	·056	·0024	2·4
16	·064	·0032	3·2
15	·072	·0040	4
14	·080	·0050	5
13	·092	·0066	6·6
12	·104	·0085	8·5
11	·116	·0105	10·5
10	·128	·0128	12·8

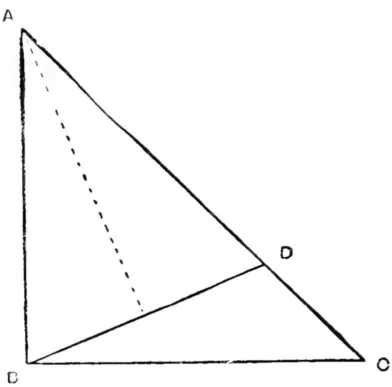
It is unnecessary to add stranded cables to the above table, as their working currents may be calculated direct from it. For instance, 7/16 S.W.G., consisting of seven strands each No. 16 S.W.G. in size, will carry 7 × 3·2 = 22·5 ampères (say). Similarly, 19/14 S.W.G. will carry 19 × 5 = 95 ampères. For currents at other current densities, multiply the current given in the table above by the density required in ampères per square inch and divide by 1,000. Thus, with a current density of 500 ampères per square inch, with a drop of 2 volts per 160 yd. (see reply 16210 on p. 353), No. 22 S.W.G. would carry $·6 \times \frac{500}{1,000} = ·3$ ampère. It may be well to add that the size of any single wire should not be reduced below No. 18 S.W.G.; smaller sizes are mentioned in the above table so that the current capacities of stranded wires may be calculated. Also, sometimes the simplest way to find the drop in volts is to multiply the resistance in ohms of the given length of cable by the current in ampères.

White Spots on Polished Furniture.—These may be caused by water spotting, damp, or the use of plaster-of-Paris as a grain filler. Try rubbing the surface with a mixture of equal parts of linseed oil, turpentine, and vinegar; then clean off any greasiness that may remain by means of a swab of clean soft rag made fairly damp—not wet—with methylated spirit. Apply this lightly at first, then, as it becomes drier, press a little harder and finish in the direction of the grain.

Making Tongues on Spokes of Cart Wheels.—Take off the tips of the spokes to about the size of tongue required with a tool somewhat like a large countersink inverted, with cutters inside, then with the hollow bit cut down to depth; this cuts the shoulder at the same time as it makes the round tongue. To do it by another method, mark in the front of the tongue parallel with the set-stick fixed to the front of the stock, by which the spokes were guided when driven in; then mark off the diameter, saw in to these marks back and front, split off, and with the draw-knife pull it out short at the sides and trim up round, using a fitter to guide the size. A tongue made this way is much stronger than when the shoulder is cut in square all round, as the grain at the side of the spoke is not cut so short.

Preparation of Pitch Pine for Varnishing.—Pitch-pine furniture is generally finished by the application of several coats of good quality spirit varnish. Interior fittings likely to be subject to hard wear are best finished with a good oil varnish, such as church oak. Pitch-pine goods are sometimes first coated with size, with a view to prevent suction. Many have a preference for first coating with spirit varnish, as it gives the articles a good colour, and any good quality oil varnish will dry thereon. If a first coat of varnish is not sufficiently hard to allow flatting with pumice in three days' time, the drying qualities are poor, or it may have been applied too thickly or by a dirty brush. Drying may sometimes be hastened by sponging down with cold clean water. Another plan is to coat with naphtha or spirit varnish; the result can also be gained by coating again with a thin oil varnish, the drying qualities of which have been hastened by the addition of japanner's gold size.

Cutting out Umbrella Covers.—For umbrella covers, first make the pattern by which to cut out the sections or gores. This may be of strong paper, but for permanent use sheet zinc is best. First cut a square of paper, each edge of which is exactly the same length as the frame on which the cover is to be placed—that is, a 25-in. frame would take a square of paper with edges 25 in. long. Cut this across from one corner to the opposite corner to produce a piece shaped like A B C in the



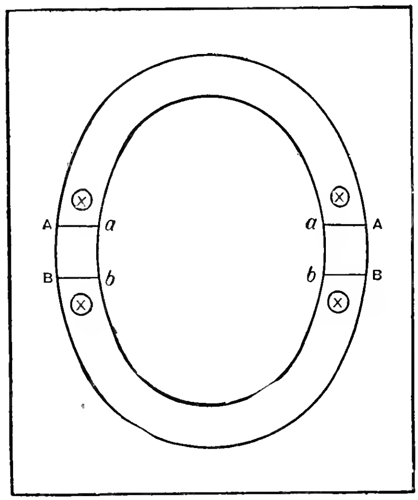
Pattern for Umbrella Covers.

illustration. Measure from A towards C the same distance as from A to B (in this case 25 in.), and then cut along the line D B. The part A D B now forms the complete pattern. By measuring down the centre as shown by dotted line, the width of cloth necessary to cut the cover will be discovered. For 25-in. covers cloth 22 in. wide is required. Always place the edges B D towards the selvedge edges of the cloth being cut, and allow a margin for hemming and sewing together. Sew the top of the cover with strong thread after machining.

Flow of Water over a Weir.—The following is a rule for finding the exact discharge of water in cubic feet, or gallons per second, passing over level weirs. The depth of the water on the weir × width × velocity, all in feet, will give cubic feet, and this × 6¼ will give the discharge in gallons. To find the exact quantity of water that is flowing over a weir would be a very difficult matter unless proper provisions were made for gauging the depth of the water and its velocity. For rough approximation the depth would be the difference in level between the weir and surface of still water above it, but with an allowance for curvature of the surface on the weir, which varies considerably. For the velocity it would be necessary to time the movement of a floating object, and from this make a deduction, as the surface travels at a higher speed than the bottom.

Hints on the Manufacture of a Speculum.—In the manufacture of specula, plate glass is used, provided the size of the mirror is not such that the disc has to be specially cast. The thickness is in proportion to the diameter, the general ratio being as 8 to 1—that is to say, the diameter of the speculum should be eight times its thickness. A safer ratio is 6 to 1—at any rate for large mirrors, where the question of flexure is an important consideration. Supposing the diameter of the speculum to be 10 in., its thickness would be 1¼ in.—certainly not less than 1½ in. Before deciding the curve, the focal length of the speculum must be determined, as this, of course, in turn determines the length of the telescope. If the latter must be short, the former must be short also, and the curve of the mirror must be correspondingly deep. This will render the figuring much more difficult to work than when the speculum has a long focus. The general practice is to make the focal length twelve times the diameter of the mirror, which, in the case of a 10-in., will be 10 ft. The curve of a speculum, though first ground spherical, is not left so, but is deepened to a parabolic form, as it is found that a spherical surface is unfitted for astronomical work. Parallel rays, when received on such a surface, result in an indistinct image at the eyepiece. Practical experience shows that the curve should be such that parallel rays received on it will come to a focus midway between the mirror and its centre of curvature. Therefore, in a 10-in. speculum the curve must be part of the circumference of a circle having a radius of 20 ft.

Making Zinc Stencil Plates.—Zinc stencil plates for marking boxes and sacks may be cut by hand with the aid of a mallet, a sharp chisel, a pair of bent-nosed snips, and a plate of thick sheet zinc. Taking the letter O, shown by the accompanying diagram, commence by drawing the



Making Zinc Stencil Plates.

letter; then, assuming that the inside part of the figure is to be held by the straps A B, A B, take the chisel, and, laying the stencil plate upon the sheet zinc plate, cut it through along the lines A a, B b, then, with a circular hollow punch, punch out the holes X, X, X, X. Insert the nose of the open snips through the holes alternately, and cut through the zinc to the corners A a, B b on both sides of the figure; then, from the open spaces formed, cut round with the snips upon the lines drawn, smooth the burr down upon an anvil with a few blows from a smooth mallet, and trim the cut edges with a smooth file to finish the plate. Letters formed by straight lines, as E or F, can be cut by the use of the chisel only.

Etching on Steel.—To write names, etc., on steel cover the surface to be marked with a thin layer of asphaltum varnish, making a little bank at the edges. On the varnish write the names, etc., with a steel scriber, and, in the small basin formed by the asphalt banks, pour a weak solution of nitric acid. When this has eaten in to the required depth, wash with hot water, removing the varnish with hot turpentine. Instead of asphalt varnish, soft beeswax is often used, and an etching fluid may be made from iodine 1 oz., iron filings ½ dram, and water about 4 oz. A solution of iodine, potassium iodide, and water is sometimes used; also a solution of 1 part of nitric acid (by measure), 1 of hydrochloric acid, and 10 of water.

Dyeing Curtains and Tablecloths Turkey Red.—The red dye fastest to light, washing, etc., is alizarin or Turkey red. For wool, mordant with a bath of sulphate of alumina and cream of tartar, and dye in a bath of alizarin paste and acetate of lime. For 100 lb. of wool use 10 lb. of sulphate of alumina, 5 lb. of cream of tartar, 10 lb. of alizarin paste, and 5 lb. of acetate of lime. The dyeing of cotton is a more complicated process.

Paint Blistering on Woodwork.—Blisters in almost all cases are due to the escape of moisture that is present in all wood, new or old. New wood is, of course, more liable than old to give off moisture, and the paint to become more blistered; but old wood will show the same effect if exposed to the heat of the sun. It may be that exposure to the sun is the cause of the paint blistering on this particular door, and in that case the only remedy is to hang over it a kind of sun-blind, made of plain or striped canvas, during the summer months. This is a very general practice in the London suburbs, and is found to be the best protective. If the door is to be repainted, then see that the work is done in dry weather and with dry brushes. The old paint will have to be burnt off, and more turps and less oil may be used with advantage in mixing the new paint, as a more porous film of paint will in this way be obtained.

Fixing Mooring Bollards.—For mooring steamers of about 900 tons, the concrete block for the mooring posts or bollards should be not less than 7 ft. 6 in. square and 8 ft. deep, with a block of Bramley Fall stone 5 ft. square and 1 ft. 6 in. thick on top. The part of the bollard above the ground line is usually a separate casting, securely bolted to the foundation column, which is bedded in the concrete, with a flange at the bottom bolted to two 12-in. by 12-in. baulks of creosoted memel. The shape of the upper casting varies from a post with rounded head and hollowed side, or a capstan-head shape, to a tall or short hook shape. The thickness of metal is about 1¼ in., tapering to 1 in. at the bottom of the concrete. The diameter where the rope goes is about 18 in., and the bottom end 15 in. The engineer of the dock usually gives the design both for the bollard and the foundation, as every part must be calculated to do its duty efficiently.

Adding an Electric Alarm to a Clock.—To fix an electric bell to a Vienna regulator clock, arrange the electric circuit so that the battery is in a convenient position, and the bell in the bedroom; include the clock in the circuit. One wire should be carried through the case and soldered or screwed to any part of the brass movement, preferably the front plate. The other wire should be carried to the edge of the dial, and should lie flat upon it pointing towards the centre, the end being brightened and hammered flat so as not to stand up much from the dial surface. A piece of paper gummed on the dial beneath it will serve to insulate it. The connection is made by the hour hand having a thin flexible piece of brass soldered to the end of it to make contact with the copper wire at the dial edge as it passes over it. This extension may be painted white, so as not to confuse the eye. This arrangement will make contact every twelve hours, but may be switched off during the day.

Reading a Gas Station Meter.—The gas made on a gasworks is always measured by the station meter, and in modern establishments corrections are made for temperature and pressure, in order that the gas may be measured under standard conditions, since, as the height of the barometer, and more especially the temperature of the atmosphere, varies at different seasons of the year, the measurement of the gas is affected in accordance with the atmospheric conditions prevailing; hence, in practice, the volume of gas passing through the station meter is always reduced to the standard conditions of 60° F. and a barometrical pressure of 30 in. of mercury. The calculations are based upon the following physical laws. By the law of Boyle or Mariotte, the volume of a given mass of any gas, assuming that the temperature is constant, varies inversely as the pressure to which it is subjected; or, in simple language, doubling the pressure reduces the volume to one-half, while, conversely, reducing the pressure one-half doubles the volume, and so on in a similar ratio. Now, supposing a station meter registered 10,000 cub. ft. of gas under a barometrical pressure of 30·5 in., and we wished to reduce the volume to the standard pressure of 30 in., since the pressure under which the gas is measured is greater than the standard pressure (30 in.), it is plain that under the last-mentioned pressure the volume would be greater; consequently, we say,

As 30 : 30·5 :: 10000 : 10166 cub. ft.

Or, supposing that we measure the same volume of gas under a pressure of 29·5 in., and we wished to know the volume at the standard pressure; in this case, the gas is measured under a lesser pressure than the standard, consequently, when reduced to the latter pressure, the volume would be reduced; so in this case we say,

As 30 : 29·5 :: 10000 : 9833 cub. ft.

It will be noticed that in each case the standard pressure (30 in.) occupies the first term in the statement. With regard to temperature, as is well known, gases expand with heat and contract with cold, and the amount of this is expressed as follows. The volume of a gas expands or contracts by $\frac{1}{492}$ part of its volume at 32° F. for every increase or decrease of 1° F. Now supposing we measure 10,000 cub. ft. of gas at a temperature of 80° F., and we wish to correct it to the standard temperature of 60° F. (the pressure remaining constant), 492 volumes at 32° F. become 492 + (60 − 32) = 520 volumes at 60° F., and 492 + (80 − 32) = 540 volumes at 80° F. The volume, therefore, of any gas at 80° F. would bear the same ratio to the volume which it would occupy at 60° F., as 540 does to 520; consequently,

As 540 : 520 :: 10000 : 9629 cub. ft.

If the gas, instead of being measured at 80° F., had been measured at 40° F., then, as before, 492 volumes at 32° F. would become 520 volumes at 60° F., and 492 volumes at 32° F. would become 492 + (40 − 32) = 500 volumes at 40° F. Then the ratio of the volume at 60° F. would be obtained as follows—

As 500 : 520 :: 10000 : 10400 cub. ft.

It will be noticed that 520 always occupies the second term in the proportion. In practice, the volume of a gas is always corrected for temperature and pressure at one operation by combining the two corrections and making a compound proportion sum of it, and as two of the terms always occupy the same position, by cancelling we obtain this expression—

$$\frac{17·333 \times p \times V}{460 + t} = \text{corrected volume},$$

p being the pressure under which the gas is measured, V the volume, and t the temperature under which the gas is measured. In gasworks, however, these corrections are usually performed by means of a series of tables drawn up by the Metropolitan Gas Referees, based on the principles already explained, but also taking into account the tension of aqueous vapour, the formula from which their numbers are obtained being—

$$\frac{17·64\,(b - a) \times V}{460 + t}$$

a representing the tension of aqueous vapour to be deducted from the height of the barometer according to the temperature under which the gas is measured, while 17·64 only differs from the 17·333 previously given by deducting from 30 the tension of aqueous vapour at 60° F. By the aid of these numbers all that is required is to observe the temperature of the thermometer at the inlet of station meter, and the height of the barometer, then find the number corresponding to them, and multiply the volume of gas by the number, when the corrected volume at 60° F. and 30 in. will be obtained.

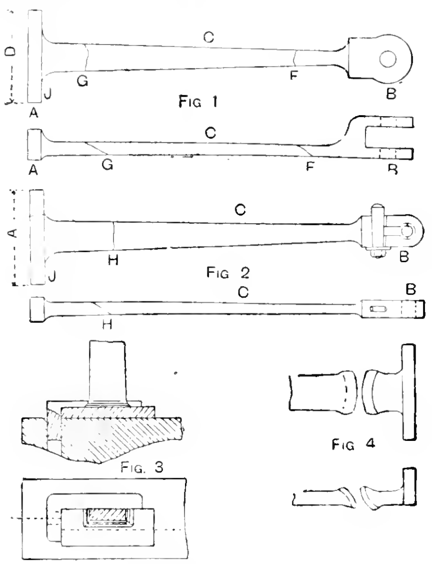
Smoky Kitchen Chimney.—It is unusual for close-fire kitcheners to give trouble by smoking, and unless the cause is down-blow (which only occurs when the wind blows from certain quarters), then it must be concluded that the range is not properly fixed. Supposing the chimney is clear, it should be ascertained whether the brickwork of the chimney above the range is well clear of the flue outlets. There should be at least 12 in. clear space between the flue outlets at the top of the range and any brickwork that may come above them. If all is right in this direction, then ascertain whether there are any means by which air can enter the chimney from the room without passing through the fire, which is a common cause of kitcheners working badly, though it may not always make them smoke. The range should be set sound and air-tight, and there must not be any other flues running into the range chimney, except, perhaps, the copper flue, which must have a damper, to be closed when the copper fire is not alight. There must not be openings of any kind by which air can pass into the kitchen chimney except it go through the fire. It must be ascertained that the soot doors are complete and in their places, and that there are no apertures in the chimney. The position of the fire in its relation to the room door need not be considered with these close-fire ranges.

Removing Fat from Sheepskins.—Practical curriers immerse the skins in fermented bran and water. Washing the skin in a solution of potash will also remove surplus oil; so also will soap and soda and water. Having taken away the oil, stretch the skin out to dry, and, whilst it is doing so, scrape it and rub it in every direction to prevent it drying hard.

Brass Polishing Composition.—Crocus is very good for polishing any metal under the hardness of iron, and it may be used for finishing iron and steel, after the rough polishing is done. It may be made into hard cakes by mixing with lard, suet, or tallow, first melting the tallow and then stirring in as much crocus as the tallow will hold, and pouring into an open oblong box, the sides of which may be taken apart to release the cake. For a paste to be put up in tin boxes, the crocus may be mixed with soft soap, with a percentage of a common oil to be ascertained by experiment, the oil preventing the paste from becoming hard. The former composition would be useful for lathe polishers, and the latter for domestic and general use.

Photographing a Procession Instantaneously.—To take a series of photographs of a procession, the camera should be directed up the road so that the procession is shown approaching. Do not attempt to take the procession broadside on, as the exposure will need to be much more rapid owing to the movement appearing far more noticeable. The most rapid plates, Cadett "Lightning" or Ilford Special Rapid, should be used. The light varies so that it is practically impossible to say what exposure to give. Much will also depend upon the surroundings, direction of light, and the character of the procession—that is to say, whether the clothing of the processionists is dark or light. Experienced photographers usually endeavour to make a couple of trial exposures on the crowd a little before the event; by developing the plates at once they are enabled to get an idea of the exposure required. For the trial exposure use full aperture, and let the shutter work as quickly as possible. Develop one plate first and make a print; from the result it may be possible to suggest how the subsequent prints may be improved. Two or more cameras clamped to the window frame should be used. They should be focussed before the procession arrives.

Forging Rods for Engine.—To forge the two rods shown in the accompanying dimensioned sketches, if steel were used and a steam hammer available in an

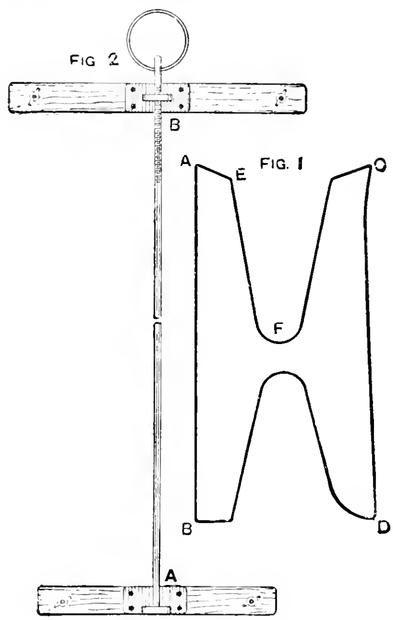


Forging Rods for Engine.

engineer's shop, the webs might be drawn down from the larger ends. Iron of common quality should be welded so that the fibre in the flat ends may run lengthways of the ends; or the ends would be opened out to form the flat. Again, where there is uncertainty about exact centres, as in valve setting, welding up to length is often done after the fitting of the ends. For convenience, the web may be drawn down from both ends, and welded about the middle or towards one end. The forked ends are, when in the dimensions given by the correspondent, forged solid, and then slotted out. They might, however, be forged roughly to dimensions over a former block, leaving little to be tooled out. As a general rule, the greater the difference in the dimensions of the two enlarged ends the greater the reason for drawing down from two pieces, and then welding. Upsetting to any considerable amount is objectionable both in iron and steel. If the whole of the work must be done on the anvil without a steam hammer, make the two ends as separate forgings, and weld the web to them with two welds (G, F) in the case of Fig. 1, and with one only (H) in Fig. 2, more drawing down being necessary in the case of Fig. 1. For the feet A, take a piece of flat bar and draw down the portion as far as H, fullering it on faces and edges alternately, and leaving the end upset for welding to the web. The inner face J is brought fairly flat by up-ending the broad face on the anvil and going over J with a hammer first, and flatter afterwards. The blows tend to make the forging strike backward, so a block (Fig. 3) must be set in the shank hole of the anvil as a support. For the other ends B, B a bar will be taken a little larger than the finished section, and the webs will be drawn down to F in Fig. 1, and to H in Fig. 2. There is very little drawing down in the latter case. All the weld ends must be upset, and the joints scarfed and rounded (Fig. 4). The lengths of the welds need not exceed 1½ in. Centre pops and a fixed trammel must be used to check the lengths during welding.

Damp Preventive for Brickwork and Stucco.—For painting brickwork and stucco exteriors to repel the damp, amongst many other materials the following have been recommended: (1) Boiled oil applied hot; (2) soft soap and alum, the latter applied twenty-four hours after the former; (3) Czerelmy fluid, presumably a silicate; (4) boiling tar; (5) silicate or other good oil paint. For stucco work a coat of Portland cement as thin as cream, applied with a whitewash brush; boiled oil applied hot and afterwards painted regularly; ordinary oil paint applied regularly.

Making Trousers Stretchers.—The simplest form of trousers stretcher is that illustrated by Fig. 1; it is known as the "Invisible" trousers stretcher, as it is used by putting it inside the trousers leg. It is made of stout iron wire. The dimensions are as follows: A to B (Fig. 1), 30 in.; C to D, 29½ in.; A to C, 14½ in.; B to D, 15 in.; A to E, 4 in.; E to F, 14 in.



Trousers Stretchers.

Of course, one is required for each leg. The device is patented. Another kind is that shown by Fig. 2, which is drawn on a larger scale than Fig. 1. Four pieces of wood, ½ in. thick and 1½ in. wide, are required; two 16 in. long, and two 13 in. Holes are bored near the ends, and the pairs are fixed together by small bolts and thumbscrews. The longer pair belong to the top of the stretcher. A metal socket is screwed on at A (Fig. 2) to receive the end of the bar, and there is a receptacle at B (Fig. 2) having a thread in it, through which the screw of the rod is turned. The rod, which is of metal, is about 33 in. in length, and has a screw for about 6 in. of its length from the top. Trousers should be folded by bringing the two front brace buttons together with the left hand, and then taking each bottom at 3½ in. from the side seam, and bringing them together also; the crease thus formed is the centre line of the leg. The trousers are thus laid in the stretcher, the bottom being fixed first, and the screws tightened; then the top as far up the leg as it will go, and the stretching is accomplished by turning the ring at the top. The articles should then be left for some time.

Filling Cracks in Blackboard.—As a filling for cracks and holes in a wooden blackboard, if the crack is ⅛ in. or more in width, a slip of wood should be fitted and glued in the opening and afterwards planed down level to the surface of the board. But if the crack is less than ⅛ in. wide, it can be filled in with a mixture of plaster-of-Paris, glue, and a little lampblack. This should be allowed to dry, and then scraped and glasspapered flush with the surface of the board.

Renovating Lacquer of Microscope. To clean a microscope that has become rusty through lying in a damp place, well rub the affected parts with paraffin. If the spots are merely superficial the paraffin will fetch them off; but if the damp has penetrated deeper, the only remedy is to remove the entire coating of lacquer, re-polish the metal, and re-lacquer. To do this, remove the lenses, take the microscope to pieces, and boil the lacquered parts with a handful of strong soda in water. This will remove every trace of the old lacquer. When dry, with some No. 1 blue-black emery paper grain the pieces as before. The old graining will give the direction. When all the pieces, screw-heads, etc., have been separately grained, they must be separately heated and lacquered. The draw tubes, if stained, need only be cleaned up with paraffin; but if it is thought desirable to paper them also, they must not be lacquered, but should be rubbed over with vaseline instead.

Silvering Brass and Copper.—Any article of brass or copper can be silvered by the French-silvering process as follows: Dissolve a stick of nitrate of silver in ½ pt. of water; add common salt, which will deposit the silver in a white mass at the bottom. Pour off the water and add fresh, stir up, allow to settle, and pour off again. The residue is silver chloride. To use it, clean the metal with fine emery-cloth, wash it in cold water, and rub its surface with salt brine. Then rub it over with a rag on which is a paste composed of equal quantities each of silver chloride, cream of tartar, and water. Continue rubbing until it is evenly silvered all over, then wash in plenty of water and dry with a soft clean cloth. Any silver chloride not used can be dried in the dark and kept in a bottle away from the light for future use. It is best to silver by gaslight or weak daylight.

Duresco and Petrifying Liquid.—The nature of Duresco and petrifying liquid, and the proper way to use them on damp walls has been explained as follows:—Duresco is a water paint consisting of pigments ground up in a medium containing water; petrifying liquid, as made by the Silicate Paint Co., is a solution containing certain chemicals which combine with stone, etc., to form a hard, impervious coating; the same result is obtained when Duresco is thinned with the petrifying liquid and applied to walls. For application to damp walls, the Duresco body colour must be thinned with petrifying liquid or Duresco liquid in the proportion of 1 to 4. Duresco is very often effectual on interior damp walls, but the benefit cannot be considered permanent, as continual dampness entering the walls from the outside rots the plaster. Duresco is no good in cases of dampness arising from foundations. The cause of the dampness must first be removed. Three coats of Duresco should then be applied thinned down with the petrifying liquid. Petrifying liquid alone will prevent moisture penetrating, but is not so effectual as Duresco, and is only used where a painted effect is not required. Three coats of this should also be given. Duresco and petrifying liquid are both patents. For porous bricks, Duresco should be applied outside the house.

Camera View Finder.—A view finder is an apparatus in which can be seen a miniature representation of the picture that is thrown on the ground-glass screen of the camera. It is fixed outside the camera in such a position, that when the image is focussed sharply on the ground-glass screen, the finder shows the same image just as sharply focussed. When a finder is used, therefore, it is unnecessary to focus the picture on the screen, the finder being used instead, and the convenience of such a procedure is obvious. A finder is absolutely necessary with a hand camera, and a very valuable adjunct to a stand camera. Care should be taken to see that the finder includes no more of the view than is shown on the screen of the camera. If the finder includes too much, reduce it to the proper dimensions by pasting strips of dark-coloured paper on the screen of the finder.

Tuning a Piano.—A wedge, a tuning hammer, a piece of ivory, and a tuning-fork are necessary. About 7s. 6d. should be paid for the hammer, for unless the temper is good the continual strain will soon cause it to wobble on the pins. Care should also be taken to ensure its adaptability for the instrument in hand; thus, some instruments are fitted with square heads, others with oblong ones to the tuning-pegs. The wedge is used to stop the vibration of one string of a note whilst the other is tuned. Wedges are usually made of lancewood, rosewood, or whalebone about 8 in. long, ¾ in. wide, and $\frac{3}{16}$ in. thick, each end being covered with varying thicknesses of doeskin; they cost about 1s. each. The piece of ivory is generally a portion of an old key covering, and is used for the purpose of plucking the wires in the first stage. A C tuning-fork costs about 1s. 3d. Tuning-forks should never be struck on any hard substance; such practices have a tendency to flatten them. Tuning may be said to embrace four stages—chipping up, rough tuning, tuning, and fine tuning; space will not permit of each stage being fully dealt with. Briefly, after the instrument leaves the stringer's hands it is chipped up—that is, the action is left out, the wires being merely plucked with the piece of ivory referred to above. When all the wires have been somewhat pulled into tune the action is put in and the tuning is followed through various stages by means of the hammer and wedge. As the tuning-pegs are merely held in position by being turned into a wood plank, care should be taken to prevent any unnecessary wriggling about; especially avoid straining the pegs upwards or downwards, instead of turning them. It requires a firm grip and strong wrist.

Yellow Stain for Oak.—A suitable stain is gamboge, steeped in methylated spirit; this yields a powerful yellow tone. If this, or turmeric, does not suffice, try lemon chrome mixed in 1 part French polish and 3 parts spirits; or a yellow aniline dye, mixed with 3 parts water and 1 part vinegar.

Stain for Edges of Brown Boots.—To make this, get a pennyworth of burnt sienna in water, and mix it with water; shake well before applying to the edges of the boots so as to get an even stain. Put it into two small bottles, say two-thirds in one bottle and the remainder in the other, with equal parts of water; this will give two shades of brown.

Hoisting the Materials for a Tall Chimney.—The usual method of hoisting the materials for a tall chimney in course of construction is to have outside the foot of the chimney a steam crab or winch, provided with a wire rope of sufficient length to reach to the top of the chimney and down again—about 400 ft. in length for a chimney 160 ft. high. In the base of the flue, a snatch-block is attached to a rail, or a rolled joist is built in. As the chimney is carried up, a couple of rolled steel joists are laid across the flue, on which is laid a plank floor, with a square opening in the centre for hoisting through, and three shear-legs with pulley-block are erected. The brickwork is carried up about 9 ft., and two other steel joists are laid across, the shear-legs being dismantled and refixed at the higher level, as is also the plank floor. When the next stage is reached, the first two joists are taken out and refixed at the higher level, and the shear-legs again moved, the operation being repeated every 9 ft. or so until the top of the chimney is reached.

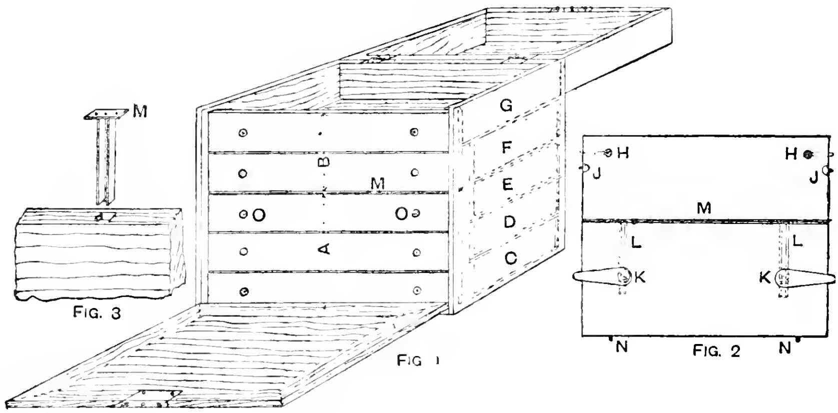
Producing Squeak for Punch and Judy Performances.—A penny squeaker is used to produce the peculiar squeak by professional Punch and Judy men for their performances, but, as a rule, these instruments are too large and roughly made. Pronounce the word "eow" or "come," and notice where the hinder part of the tongue touches the roof of the mouth. This is where the instrument must be placed, and held in position by the tongue pressing it against the palate, while the front portion of the tongue, the lips, and cheeks are left free to modulate into words the sounds produced by blowing through the squeaker. A serviceable one may be made of two pieces of tin, 1 in. by ½ in., slightly curved, with a silk ribbon, ¼ in. broad, stretched tightly between and wrapped round once or twice. The whole is tied round with thread. The corners should be cut off the pieces of tin, or they will injure the roof of the mouth. The silk produces a clean, smooth voice, although for open-air performances, where a very loud voice is requisite, ordinary tape in a larger squeaker is preferable.

Heating Cucumber House.—To heat a glass house, size about 10 ft. square, for growing early cucumbers, a boiler to burn coke, with 3-in. or 4-in. cast-iron hot-water pipes, is recommended. A gas boiler would not prove so economical and requires careful fixing to shelter it from the wind and weather, which may cause it to light back or be extinguished. The Loughborough type of boiler, which is supplied with pipes, etc., complete, is generally found to be suitable. The pipes have expansion joints, and the whole is expressly made for amateurs' requirements, no skill being needed in putting up the apparatus. The boiler is fixed in the thickness of the wall and requires no pit or special provision of this kind. If the height of the house averages 7 ft., then 35 ft. of 4-in., or 46 ft. of 3-in., pipe will be required. The pipe can be carried along two or three sides, below the glass, where the house is expected to be coldest.

Removing Stain and Varnish from Furniture.—To each bucketful of freshly slaked hot lime add about 2 lb. of common washing soda. Apply liberally by means of old brushes. Carved portions may be cleansed by making the mixture into a paste by adding more lime or sawdust. Spread this over by means of a palette knife. Several applications may be necessary. Swill off with clean water, and finally wipe over with common vinegar to neutralise any trace of acid left in the wood.

Solutions for Etching on Brass.—A reliable solution may be made by dissolving nitric acid in about five times the quantity of water. Another solution is made by mixing a solution of nitric acid and water (1 to 10 parts respectively) with about an equal quantity of potassium chloride dissolved in 16 of water. A mixture of nitric acid 20 parts with 1 of muriatic acid, may be used, or a solution containing equal quantities of nitric acid and water and a few small pieces of copper may be tried.

Jewel Case with Secret Drawers.—The following instructions for making a jewel case with secret drawers refer to one about 12 in. by 10 in. by 8 in. Fig. 1 is a view of a jewel case when open; the carcase is put together with secret dovetail and mitred joints. The front or flap is mitre clamped and veneered on the face; the four drawers which the case contains are all hidden. The front A B (Fig. 1) is made in two parts, and represents the fronts of five drawers, A being made the height of drawers C, D, and E, whilst B is the height of drawer F and tray G. The bottom of G is a fixture, as are also the divisions between drawers F E, E D, D C; the front A is made as shown, with two scratch beads at equal distances. The bead M, which divides the front, is loose; to it are fixed two steel forks, which fit into the square mortises (Fig. 3); the two drawer knobs K K (Fig. 2) have a small square spindle attached, over which the steel fork passes, and fixed on the end of the spindle is an iron tongue and nut forming a turn-buckle. When the knob is turned so that the front is fixed, the fork K is dropped and fixes the front A, and, until lifted, the latter cannot be moved. N N are dowels fitted into the bottom of the case; the front B is made to work on pivots J J and is fixed by springs H H (Fig. 2). These springs are hidden by the silk lining of the tray, and, until released, the front A will not move; when the springs are released the front will fall on the bottom of tray G, giving access to the bead M. In a shallow case it will be necessary to form the movable knob at O O, or the forks L L will not draw out sufficiently to release the front A.



Jewel Case with Secret Drawers.

Glazing Tobacco Pipes.—For a glaze, dissolve 1 part of acetate of lead (sugar of lead) in 5 parts of water, and dip the pipes into the solution or apply with a brush; then, after drying, fire at a low red heat. Another glaze is made by melting together in a crucible 1 part of carbonate of potash and five parts of borax; pour the melted mass into an iron plate, powder it very fine, and mix with turpentine. Apply the wash with a brush and fire as above.

Standard Acid and Alkali Solutions.—Standard acid and alkali are solutions of an acid or alkali the exact strengths of which are known. The usual standard solutions are the "normal" and the "decinormal." The normal solution of hydrochloric acid contains 36·5 gram. hydrochloric acid in 1 litre; the decinormal contains one-tenth of this amount. The strength of a solution of an acid or an alkali is determined by measuring, say, 10 c.c., and titrating with either alkali or acid, as the case may be, and using some indicator, such as litmus, which changes colour when the point of neutrality is reached; the standard solution is dropped in from a burette, and when the titration is finished, the amount of standard solution used is read off, and from this it is easy to calculate the amount of acid or alkali present in solution. A "factor" is sometimes used for calculation when the strength of the standard solution is not exactly correct: for instance, suppose we have an absolutely correct standard acid, and we then make a standard soda solution which is rather too strong, instead of diluting it to the correct strength, we may use it as it is, and multiply the results by a "factor." Suppose 10 c.c. of the standard acid requires 9 c.c. of the soda solution, then the latter is $\frac{10}{9} = 1{\cdot}11$ times too strong: the figures 1·11 constitute the "factor."

Laying Concrete Floor.—Although some experts recommend that, for stability, a concrete floor should be laid in three layers, the upper and lower of strong material, having the bulk of rougher material between them, this plan is not followed to any great extent, and the utility of the intermediate course is doubtful. In order to make a strong homogeneous concrete, the voids in the aggregate must be filled with some finer material; it would be an improvement if the material intended to form the first two layers were incorporated and laid as one. The finishing coat may, if desired, follow closely upon the laying of the rougher material, but it will be better if the bulk is allowed to set first; and three days afterwards will be a very suitable time to finish off the floor, provided there is no need of hurrying the work forward. After the fine stuff has been ruled off, as soon as the surface begins to get firm, is the proper time to commence finishing-off: if this is commenced too soon, an unequal surface will result, whilst if the stuff is left to get too firm, the surface will be rough and patchy. A hand float should be used at first, and with this the work should be beaten lightly, or patted until the "fat" appears; then trowel off with light strokes until the desired face is obtained.

Preparation Used by Fire-eaters.—The preparation used by so-called fire-eaters to make the skin resist the action of fire is strong solution of calcium chloride which would remain moist on the skin and protect it to some extent. The fire is obtained by burning a small quantity of the lightest naphtha. This rapidly dies out, and produces but little warmth. This naphtha is often poured on tow and ignited, but the flame at once dies out when placed inside the mouth.

Boiled Oil as a Damp Preventer for Brick Walls.—Boiled oil has been highly recommended as a cure for dampness caused by absorptive bricks. Its efficacy is due to the fact that it fills the pores of the bricks. It should be applied boiling hot, and rather lavishly, with a large paint brush or even a Turk's head brush. A dry summer day should be chosen, and if possible, a time when the wall is warmed by the sun. The coating should be renewed every two years. It may rather discolour the brickwork if the facing is new stock or terra-cotta bricks, but will hardly be perceptible with old or common work. A small area should be tried at first, so as to afford some idea as to the ultimate appearance of the whole.

Re-enamelling Bath.—To re-enamel a hot and cold water bath, specialty prepared enamel paints are used. Thoroughly clean the surfaces of the bath with petroleum and well scour rusty places with emery cloth; when clean and dry, rub in a paste of lime and petroleum; wipe this off before painting. Apply two thin coats of paint; allow the first coat to dry hard before applying the second. Pale green or eau-de-nil are good tints.

Printing Photographs on Fabrics.—There are several methods of printing photographs on fabrics. The simplest is the platinotype, as the material—silk, satin, linen, calico, etc.—is supplied sensitised and ready for use by the Platinotype Co. It is treated in the same way as paper, being printed to the required depth and developed by immersion in a saturated solution of oxalate of potash or in the D salts supplied by the company. It is fixed by immersion in one or two baths of hydrochloric acid—strength 1 in 60—and merely requires half an hour's washing in running water. A very permanent image which will stand washing may thus be produced. The prepared material is somewhat costly, therefore the following plan may be preferred. Procure some pure silk—not treated with acetate of lead—and immerse for two or three minutes in a salting solution prepared as follows: Boil 2dr. of arrowroot in a little water and dissolve and add 75gr. of chloride of ammonium and make up to 32oz. of water and filter. When the silk is dry, a sensitising solution of silver nitrate 40gr., citric acid 1½gr., water 1oz. is brushed over it, the fabric being pinned flat on a board. Print as usual, but very deeply, and tone with water 5oz., sodium acetate 7gr., chloride of gold 3½gr. Allow this bath to mature for twenty-four hours before using it. Very pleasing results are obtained by merely fixing without toning. Well wash before toning, and place in a bath of common salt and water before fixing in hyposulphite of soda 2oz., water 1pt. The pictures may be coloured with crayons and a very beautiful effect produced. The crayons may be fixed by spraying with a solution of rubber in benzole. The picture, if not coloured, may be washed in cold running water. By the "Primuline" process prints on a yellow ground may easily be obtained in red, scarlet, crimson, maroon, orange, brown, etc., by sensitising with primuline and treating after exposure with a developer. In printing fabrics, great care must be taken when examining the print lest the material should be stretched, when a blurred and distorted image will result. Gauge the exposure by experience, or use an actinometer, when the material may be stretched on a light frame. Absolute contact must, however, be assured. The grain of the material must not be too marked or a coarse effect will result.

Sinking a Tube Well through Chalk.—A deep stratum of chalk would be penetrated by boring, for which purpose a tube of large diameter is necessary. A frame, which holds the first length of tube in position vertically, is set over the selected spot. The lower edge is not sharp, but rough jagged, and the work is performed by revolving the tube by means of a portable engine and horizontal pulley wheel on the frame through which the tube passes and to which it is wedged; a bag of sand placed on the top of the tube adds weight when required. When one length is nearly down, the boring is stopped and dredging commenced. A heavy piece of tube, about 2½ft. or 3ft. long and small enough to go inside the well tube, has its lower end edges slightly sharpened and is fitted with a valve; a small bar is riveted across the upper end, and filed off flush outside. To this bar is attached a piece of strong cord—that known as "cod line" is suitable. By repeatedly dropping this down the well tube and pulling it up and emptying, etc., the borings are withdrawn; when advantageous, water is poured in. Lengths of tube are added as the boring proceeds.

Welding Cast Steel.—In welding cast steel, the flux may consist of borax ¼ lb., washing potash ¼ lb., and a small quantity of powdered white glass. These should be melted together and pounded. Cast steel should be kept from the air when heating over breeze—not coal—and should not be raised to too high a temperature, as it is liable to burn. The blows should be light at first. The flux mentioned above should be thrown over the surface to be worked before the material is put into the fire, more being added afterwards as required.

Cutting Steel Type and Dies.—For steel type and die-cutting a considerable plant of tools is required, consisting of, for steel-type work, a strong bench, heavy vice (about 56lb.), an assortment of large coarse and small fine files, gravers, hammer and chisels, spring dividers, rule, square and straightedge, pump drill, grindstone, oilstone, scriber, long pliers or tongs, handshears, sheet-tin, and cast steel in rod; and for die-sinking work, a die-sinker's vice and hollow pad, chisels, punches and matts, curved and straight rifflers, and hand-vice. To cut type, first soften a suitable piece of cast-steel rod, file up the sides with a slight undercut, and dress the face; then scribe in the type, or, better still, mark it from a tin template. Any round holes in the face are drilled with the pump-drill; the inside work is chipped out with lozenge and round-nose chisels; the outside edges are filed in a series of vee-shaped notches to form the outline of the type. Finishing is done with gravers, holding the work (if long enough to be handled) in the left hand, or in a hand-vice against a filing slip of wood projecting from the edge of the board, and lightly cutting and skimming with lozenge and round-nose gravers. Try the work from time to time on soft lead or wet clay; when perfect, put it into a clear coke fire, heat to a cherry red, and quench in clean cold water. Then temper to a middle brown. Should any further dressing be required, procure some boxwood splints and dress off with fine emery and oil. Dies are made with a backing of iron faced with steel, the better to withstand the blows of the stamp. Most dies are either planed level top and bottom, or turned in a lathe. In this state the blank is screwed up in the die-sinker's vice, and the face dressed up with a dead smooth file. A template is now placed in the centre of the face, and the shape deeply scored with a scriber. The line may then be cut round, using hammer and lozenge chisel. If no pattern is supplied, a model must be made in modelling wax, clay, or plaster-of-Paris; and to get the depth of the die, use a sectional tinplate template. After rough chiselling, use hand-gravers to remove the chisel marks, and follow by rifflers of various curves and contours. The die can be finished dull smooth with emery and oil, using a light or heavy stick for dressing, according to the size of the work. These dies are hardened and tempered by the blacksmith who forged them, and then further dressed, using a stick, finer emery, and oil. Other dies, in addition, require to be burnished with small curved steel burnishers, lubricated with ordinary soap and water. The various plain and ornamental punches and matting tools used by the die-sinker are generally made by himself, and it is seldom that the branches of type-cutting and die-sinking are carried on by the same person.

Photographing Coloured Pictures.—Coloured pictures, or any coloured object, can only be photographed successfully by the help of a screen or interceptor, which gives the true tone values of the colours. In addition, the emulsion with which the plate is coated must be specially sensitive to red and orange. Such plates (termed chromatic, isochromatic, or orthochromatic, or colour-correct) may be had of all dealers in photographic materials, those of Edwards being particularly good. These plates must be developed only in a dull ruby light. Pyro-soda is the most suitable developer. The screen may be fixed either before or behind the lens, and may either be made by staining a sheet of gelatine in a weak solution of picric acid, or purchased ready for use. Generally, the screen should be a very pale lemon yellow, but the more the two colours named above predominate, the deeper should be the tint.

Making Taps for Watchwork.—Taps for tapping screw-holes in watchwork should be made of good steel wire. First soften it by heating to a red, and allow to cool. Then file to a slow taper and thread it cautiously, using plenty of oil. When a full thread has been cut, file it triangular, and smooth the flats with a pivot file. Harden it by heating to a bright red and plunging in oil or water. Brighten the flats with a smooth emery stick, and lay the tap on a brass plate held over a lamp flame until the brightened flats show a pale straw colour.

Red Terra-cotta and Blue Bricks.—The varieties of clay used in the manufacture of terra-cotta are the blue, buff, and red clays of Cornwall, Devon, and Dorset, red London clay, and many others. Some varieties of Leeds clays are also employed. These are plastic clays, containing a moderate but variable quantity of oxide of iron—from 1½ to more than 11 per cent. The clay is treated in several ways. In some districts it is ground in the dry condition, and then mixed in pug mills; in others it is ground wet to a "slip," which is dried to the proper consistency for working on the "slip" kiln. It is usual, especially for large objects, to mix the clay with a moderate proportion of ground-baked clay, old pots, ground flint, sand, or Cornish stone, in order to prevent excessive shrinking and warping, and it is essential to allow the tempered clay to stand for some time before working. The ordinary terra-cotta bricks, facing blocks, ornamental tiles, etc., are machine-pressed, but fine objects are pressed in plaster moulds, and the larger objects are often built up and modelled by hand. Blue bricks are usually made by incorporating "mill cinder" or "iron scales" with the clay, the bricks being burnt at a very high temperature.

Lacquering Copper and Brass Candlesticks.—Take them to pieces and boil in a strong solution of soda to remove old lacquer and dirt. Dip in a weak solution of nitric acid and re-polish them. Then make them hot in an oven or on a hot plate and brush over with pale gold or gold lacquer. Candlesticks may be freshened up by brushing them over with a coating of zapon or brassoline, which may be procured through a chemist or oil and colour stores.

Wiping a Plumber's Underhand Joint.—The pipes having been dressed out straight, square the ends with a rasp. The burr should be cleaned out of the end of one pipe, and the outer arris cleaned off (see Fig. 1). Open the other pipe-end (Fig. 2) by means of a turnpin, so that the first pipe will enter as far as it is rasped off. Clean up with glasspaper and smear the pipes with a little whiting or chalk Now mark the pipes at 6 in. from their ends by means of a gauge (Fig. 3). Paint the end of the pipe as far as the gauge mark with warm soil or smudge, and then with a shave-hook shave the pipes to a distance of 1¼ in. from the end of the first (Fig. 1), and 1½ in. from the end of the second (Fig. 2). Shave also the rasped parts of both pipes. They must now be rigidly secured in position by laying each pipe upon two bricks set on edge or upon two lengths of quartering and then holding them down by string as shown in Fig. 4. On the bench immediately beneath the pipes place a sheet of brown paper to catch the solder which falls in the process of wiping the joint. Smear the shaved parts of the pipes with tallow, which acts as a flux. Have conveniently near a pot of solder of the proper temperature, and then, with a ladle in one hand and a wiping-cloth in the other, commence to make the joint. The first stage is to pour on the metal and "tin" the joint, the second is to shape the joint, and the third and final stage to wipe it smooth. Pour the metal on to the shaved part and on about 2 in. of the soiled portions. Hold the cloth under the joint to catch the surplus solder. As the solder runs down the sides of the pipes it is caught by the cloth and pressed up against the bottom, thus helping to get up the heat and to tin the pipes. The joint should be formed quickly by wiping it with the cloth, which should be kept at the same curve all round the pipe, and pressing the edges so as to get them clean. Fig. 5 illustrates the finished joint.

FIG. 1

FIG. 2

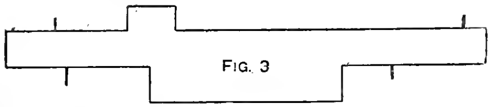


FIG. 3

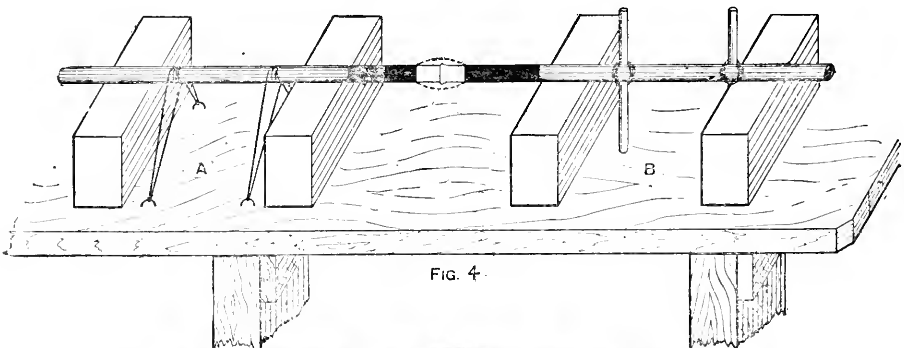


FIG. 4

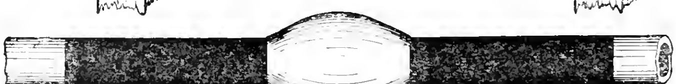


FIG. 5

Wiping a Plumber's Underhand Joint.

Quantities for Concrete.—Approximately, the voids in gravel, if free from sand, may be estimated at from 25 to 30 per cent. of the bulk, and in broken brick or stone at from 40 to 50 per cent.; but if it is desired to obtain an accurate estimate of the voids in any sample of aggregate, fill some known measure with the material, then add water until the measure is filled; the quantity of water necessary for the purpose will be the amount of the voids. When dealing with porous materials, the water should be measured beforehand, and added to the aggregate quickly; subtracting the remainder from the original measurement of water will then indicate the extent of the voids. But in calculating the amount of sand and cement necessary to fill the voids, it must be borne in mind that Portland cement and sand both lose bulk when water is added to them, the former by about 10 per cent. and the latter by about double this percentage. It will thus be seen that the result in cubical measurement of the materials indicated in the question will be only about that of the rough aggregate, namely, 5 yd.; and if the concrete is consolidated by ramming, there will be a further decrease in bulk by about 20 per cent., thus reducing the bulk to about 4 cub. yd.

Painters' Fillings.—The fillings used for stopping the suction of wood, plaster, etc., previous to painting, may vary according to the nature of the work. A very commonly used filler is made from starch by incorporating with it some linseed oil and varnish, adding a drier, and then thinning with petroleum naphtha. The American fillers are made from inorganic materials, such as ground silica, steatite, china clay, or barytes, and these are ground with raw linseed oil, grinding japan, and turpentine or liquid driers. These fillers set extremely hard. They are coloured when necessary with the usual pigments. A very common filler for plastered walls is made by dissolving good jelly size in hot water, and thoroughly mixing with it sufficient whiting to give it body.

Wash for Stained Stucco Work.—There is a wide range of choice in the many washable distempers now on the market; but whether any of them would cover defects so as to prevent their re-appearance depends entirely upon what causes the stains. If they are lichenous growths, an application of dilute sulphuric acid will have a beneficial effect in the matter of destroying the vegetation, but a deleterious effect upon the stucco, the surface of which will be more or less disintegrated, according to the strength of the acid. Try the effect of a good brushing with a stiff bass dandy; then, for a cheap wash, and one that will look better than a white preparation, add Portland cement to water in which white copperas has been dissolved at the rate of 1 lb. to 3 gal. Apply the mixture, with frequent stirring, in the same manner as distemper. A second coat may, if considered necessary, follow as soon as the first is dry.

Papier-mâché Mouldings.—For making papier-mâché mouldings as used for theatrical purposes, obtain some thick, coarse brown paper; tear it into small pieces 3 in. or 4 in. square, and soak them in cold water. Now make some good flour paste, and while hot, to half a gallon of paste add about half a pint of linseed oil and about half a pound of melted glue. Well mix these together. Now squeeze the water from the paper and paste each piece thickly on both sides, placing them one on the other to keep them moist. These pieces are taken up separately and pressed into the mould, which need not be filled level, but left hollow so long as the whole of the design is well carried out. Plaster-of-Paris is used for making the moulds. The design is first made in clay or cut in wood. Make a strong box a little larger than the model; pour into this box the wet plaster, and press in the model, having previously brushed the model over with a little sweet oil so that it will not adhere to the plaster. When the mould is hard set, line it with oiled tissue paper before pressing in the papier-mâché; allow this to well set and get partially dry before turning out. The mouldings may be fixed with needle-points and glue.

Vanadium.—This is one of the metals of the antimony group, and may be obtained as a greyish-white powder. It will decompose water at a temperature of about 90° C., and does not tarnish in the air. It is insoluble in hydrochloric acid, but dissolves rapidly in nitric acid and slowly in hydrofluoric acid. It burns readily and, in a current of chlorine, takes fire. It has been found in some iron ores, in copper-bearing beds in Cheshire, and in iron slag in Staffordshire. Its symbol is V, and its atomic weight 51·4.

Heating Greenhouse by a Flue.—In heating a small span roof greenhouse, 12 ft. by 8 ft. by 5 ft. to eaves, by a flue, the chief points to remember are that the horizontal portion of the flue must have a rise of 1 ft. in 10 ft., and the vertical part of the flue at the end of the rise must not be less in height than the length of the horizontal part. At the base of the vertical part there must be a soot door for sweeping, and also to admit of some burning shavings being inserted to start the draught, as will very likely be necessary whenever the fire is freshly lighted. A small furnace will do, and the flue, built of ordinary stock bricks, can be 7 in. by 7 in. inside. If the flue is carried across the 8-ft. end it will do, as close to the floor as possible. This will give a slightly different temperature at the two ends of the house, so that both half-hardy and very delicate plants can with care be accommodated.

Curing Goat's Skin.—Trim it on the flesh side with a sharp knife, and then well brush with a solution of $2\frac{1}{2}$ lb. of alum and 1 lb. of common salt in 1 gal. of warm water; the skin should be treated two or three times with this solution on successive days. Now sprinkle bran all over the skin, brush out, and nail the skin to a board and dry it. As a preservative against insects, the flesh side of the skin may be treated with a mixture of arsenic and black pepper previous to drying on the board.

Inlaying Raised Frets in Finger-board of Guitar.—Get a small piece of a broken keyhole-saw, and insert it, teeth outwards, in a block of wood; this will cut a groove of uniform depth. The projection of the teeth must be correctly determined beforehand. The frets may be made of stout brass wire hammered carefully so as to partly flatten it.

Reeds of Organ Pipes.—These consist of a piece of hard-rolled brass, fixed by a wedge upon the flattened segment of a short cylindrical tube closed at one end, as ᗜ. This is inserted in a solid block resting in an inverted cone of sheet metal (termed a boot) and supports a tube which reinforces the tone required.

Heating Schoolroom.—A schoolroom 66 ft. by 35 ft. by 22 ft. high has nearly 51,000 cub. ft. of space in it, which, with an ordinary area of window glass and good walls, can be heated by 9 ft. of 4-in. pipe per 1,000 cub. ft. of space. This will give 55° F. in very severe weather, and 60° F. at any other time. If 60° F. is required in severe weather, then 10 ft. of 4-in. pipe per 1,000 cub. ft. must be allowed. If 2-in. pipe is used, then double the length will be required. The advantage of 2 in. pipe is that 2 ft. of this only holds half the water that 1 ft. of 4-in. does, and this means getting the heat up in half the time after lighting the fire. If radiators are used, the heat can be got up still more quickly, as they hold the least practical quantity of water for a given radiating surface.

Putting Geneva Watch in Beat.—To see roughly where to put the hairspring on a balance so that the watch is in beat, after putting in a new hair-spring, look at the opening in the cylinder; this should face the 'scape wheel. Usually there is a small dot on the balance rim against which the hairspring stud should be placed. To try finally, see that, when the watch is wound up, the balance when stopped by the finger has no more tendency to stop on one side than the other, and always starts off immediately it is released.

Repairing Hole in Boat.—Cut out the plank at the part and replace it with a well seasoned piece, butting the remaining parts of the plank over a rib. If thought necessary, put in an extra rib or two, if the hole is above water-line. An easier method is to push the edge of a piece of sheet copper under the plank, double it over the hole, hammer it close, and tack down with plenty of copper tacks; the part should previously be painted. Cracks may be filled with a putty made of red lead, white lead, and copal varnish.

Soldering Spout on a Copper Kettle.—To re-solder a spout on a copper kettle, first thoroughly clean the copper where the spout is to be inserted with a piece of emery cloth, and also clean the spout around its large end. Then tin the copper inside the kettle where the spout is to be soldered, and also the spout, using killed spirits as a flux. Pass the small end of the spout through the hole from the inside of the kettle, and press it up so that the small flange on the large end of the spout butts against the side of the kettle; then solder round the spout on the inside of the kettle, and leave a thin body of solder floated smoothly round where the join occurs, the same flux being used as for the tinning. Solder composed of $1\frac{1}{2}$ lb. of tin and 1 lb. of lead would be suitable for this purpose.

Clarifying Glue or Gelatine Syrup.—Decant it into a tall tank and let it rest for several hours, when most of the impurities will settle to the bottom, and, after decanting the glue, the bottoms may be added to the next boiling. If a large quantity of glue solution is to be treated, the heat contained in it will be sufficient to keep it fluid; but for a small quantity a jacketed pan must be used for clarifying. The addition of a very small quantity of alum to the glue solution is beneficial, as it coagulates the flocculent matter and renders it heavier. For gelatine, moist alumina would be suitable as a clarifying agent, or inert white powders, such as china clay or French chalk; these substances should be stirred into the gelatine solution and allowed to settle out. Experiments on the lines indicated should be tried on a small scale first.

Repairing Damaged Stonework.—It is presumed that the stone from which a piece has been accidentally broken is one of the Yorkshire "grit" stones, similar to that obtained from the Howley Park or Idle quarries. For mending this kind of stone, mix resin and beeswax in about equal parts over a fire, or preferably over a hot plate, till both are thoroughly incorporated. Pour the mixture into water, and, after it has been well manipulated and allowed to cool, make it up into sticks. To unite the broken pieces, warm the stone, by means of hot irons, sufficiently to just melt the cement. Apply the cement to the fracture, then press tightly and firmly till set. This cement, however, has no lasting properties when exposed to the weather, but will answer for internal work. If the piece broken off is not too large, use Portland cement mixed with some of the pounded dust of the stone, and a little mineral oxide to give it the necessary colouring. This will make a far more satisfactory and lasting job.

Proportions of Sand and Lime for Mortar.—In mixing lime and sand by bulk, and not by weight, it is necessary first to ascertain the cubic feet contained in the lime, a cubic foot of which weighs 39 lb.; hence 5 tons × 2240 lb. ÷ 39 lb. = 287 cub. ft.; multiplying this by 3, it is found that 861 cub. ft. of sand will be required, the weight of which can only be obtained by experiment, pit sand being given variously as from 90 lb. to 100 lb. per cub. ft.; river Thames sand, from 91 lb. to 102 lb.; river sand, 117 lb. to 118 lb., etc. Thus, with sand at 90 lb. per cub. ft., $34\frac{1}{2}$ tons will be required; with sand at 100 lb., $38\frac{1}{2}$ tons; with sand at 112 lb., 43 tons; and with sand at 117 lb., 45 tons. About 8 tons of water will be required for slaking and mixing; there will result from 45 tons to 55 tons of mortar, varying both according to the weight of the sand used and the consistency to which the mortar is mixed. The exact weight can only be ascertained by experiment.

Enlarging Photographs without a Camera.—The best enlargements are made by utilising a room as a camera. The window should be blocked up with a screen in which should be cut an opening just large enough to be covered by the reversing back of the camera; outside the window, fix, at an angle of 45°, a white board or other reflector, which should be about three times the diameter of the reversing frame, but if the window has a clear view of the sky, the reflector may be dispensed with. Adjust the camera against the opening, with the lens pointing into the room, and insert the slide containing the negative, both shutters being drawn out. The picture should be focussed on a sheet of white paper or board placed on an upright easel or other support, the easel being moved and the lens racked out until the proper focus is obtained. Then cap the lens, place the bromide paper in position, and expose.

Autograph Moulds for Rubber Stamps.—To get a satisfactory mould, great care in all the processes is essential. Coat a piece of flat metal plate evenly with melted beeswax to a depth of about $\frac{1}{16}$ in. Before this has got quite hard write slowly what is required; make the pencil or stylus penetrate to the metal, quite through the wax, from end to end of the autograph. Clear out any shavings or chips of wax that may clog the writing. Sift some plaster-of-Paris through fine muslin; dry the powder in an oven, making it hotter than the hand can comfortably bear. Grind it up with a pestle and mortar to remove all traces of lumps, then sift again. Replace in the mortar and add enough water to make a thick cream, using the pestle to get thorough mixture and to leave no unwetted powder. Pour the cream upon the wax autograph and pat it with a light stick, so as to force the cream into the grooves of the writing. When the cream has set quite hard there should be a perfect facsimile. A similar procedure will obtain the true mould from the plaster facsimile.

Ink Eraser.—One kind is made by dissolving 1 part of oxalic acid in 10 parts of water. Another kind can be made by adding 1 part of chloride of lime and $\frac{1}{10}$ part of strong acetic acid to 10 parts of water. Oxalic acid is a powerful poison, and I should therefore be handled carefully. Chloride of lime solution should be kept in small closely stoppered bottles.

Thermo-electric Piles.—The simplest form is shown in Fig. 1. It consists of a number of strips, say of bismuth and antimony. These are joined, and alternate junctions, as 1, 3, and 5, heated as shown, while the other junctions are cooled. The action is very weak; for instance, for a single pair of these metals the electromotive force is only about 120 microvolts $\left(\frac{120}{1,000,000}\text{ volt}\right)$ per degree centigrade difference of temperature between the junctions. Even this electro-motive force is lowered by the "Peltier" effect, and the piles are racked by stresses due to expansion and contraction. The following table gives particulars of the thermo-electric properties of some metals, the electro-motive forces given being those obtained by junctions of the particular metal with lead, the difference of temperature being 1° C.

Metals.	*Electro-motive Force.*	*Metals.*	*Electro-motive Force.*
Bismuth ...	+ ·000068 volts	Lead ...	—
Nickel	+ ·000024 ,,	Copper	– ·0000017 volts
German silver	+ ·000015 ,,	Silver	– ·0000029 ,,
		Zinc	– ·0000035 ,,
Aluminium	+ ·0000006 ,,	Iron	– ·000015 ,,
Tin	+ ·0000001 ,,	Antimony	– ·000046 ,,

The current flows from the metal that is higher on the list; thus, comparing bismuth and antimony, from the first to the second. The value of the electro-motive force for any pair of metals is the algebraic difference of the numbers given in the table; thus, of bismuth and antimony it is the difference between + ·000068 and – ·000046 = ·000068 + ·000046 = ·000114 volt, and between antimony and lead the potential difference is the difference between ·000058 and 0, or ·000058 volts. The physical conditions of the metals have much effect on the voltage; thus, hard platinum is thermo-electrically negative to soft platinum. A section of Clamond's thermopile is shown in Fig. 2. The elements consist of block A, of an alloy (two parts tin and one part zinc), and arms of sheet iron F. The latter project and offer considerable surface to the air, so that the joints numbered 2, 4, 6, etc., to 20 are cooled. The inner junctions 1, 3, 5, etc., to 19 are heated, an earthenware cylinder with holes across it allowing coal-gas jets to play on the joints. Five such layers were used. Another form of Clamond pile is shown by Fig. 3. In this the hot gases from a coke furnace F pass up through the flues T, O, and P, and out at the chimney at A. The elements are shown at C, while copper radiators D attached to the outer junctions, but insulated from them, serve to increase the difference of temperature. It is said that from a battery with 3,000 couples the total electro-motive force obtained was 109 volts, the internal resistance being 15·5 ohms. The temperatures of the junctions were not stated, but 11 lb. of coke was burned per hour.

Pendulum and Rod for Dutch Clock.—The pendulums of Dutch clocks only weigh an ounce or two, and the bobs are usually made of turned wood about 2 in. diameter and $\frac{1}{2}$ in. thick. The rod is of iron wire, hammered flat at the top end and turned over into a hook. This is hung on a wire loop at the back of the clock for a suspension. The usual length is from 24 in. to 28 in. One should be made full length, and then shortened until correct. There need be no regulating nut, the wooden bob merely sliding on the wire rod friction tight.

Colouring Matter Used for Gelatine Photographic Films.—The colouring matters used depend on the purpose for which the plates are required. Eosine, alizarine blue, ceruline, etc., are employed. Eosine is generally used for isochromatic plates. This colour fades in direct sunlight, but would not do so in the fraction of time required for exposure.

Dry-cleaning Valencia Waistcoat.—To dry-clean a striped Valencia waistcoat and lining, cut 2 oz. of Sunlight soap into shavings, and pour over it $1\frac{1}{2}$ pints of boiling water in which is placed a small piece of alum. Beat this into a lather and leave to cool. When cool it will be the substance of a jelly. Apply this to the waistcoat with a close sponge; do a few square inches at a time. With another sponge, wash off the substance with a very little tepid water. Then squeeze the water from the sponge and dry the material. Repeat this process till the vest is finished. Then hang it up until thoroughly dry, and dry-press.

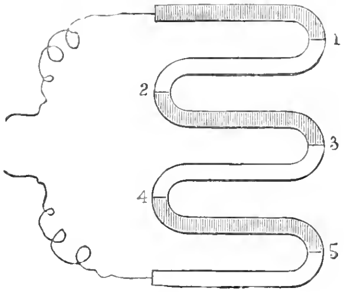


Fig. 1

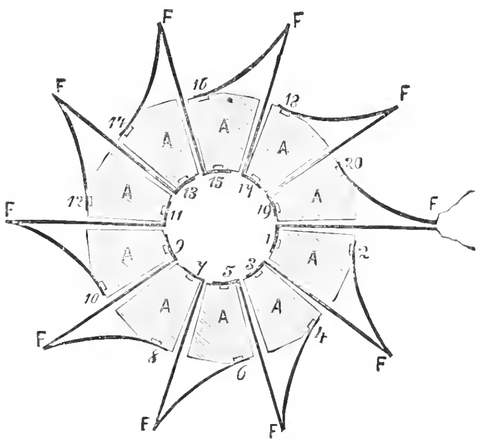


Fig. 2

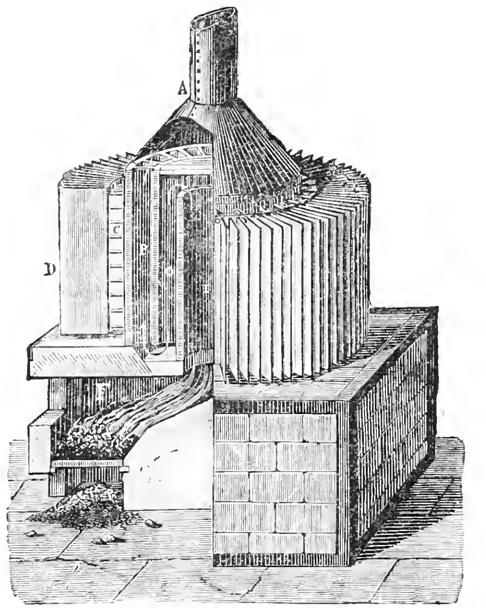


Fig. 3

Thermo-electric Piles.

Lining Out Cart Wheels.—When lining out a cart wheel one of the best ways is to tilt the horse back, by putting a block underneath the front part, to any angle required (being careful not to overdo it, or wheel and horse will overbalance), then gently revolve the wheel, ganging the lines on in the usual manner. By this method there is not so much chance of getting jumps in the lines as when done on a box. The fronts of the spokes can also be done when in this position; the stock should be done with the wheel on the horse in its ordinary position. If, after lining the surface, it is uneven, take some glasspaper and cut down the ridges caused by the lines, and give another coat of paint. The prices of colours vary according to quality, but for experimenting a green is best; this can be mixed to so many shades, and various colours in lines blend well with it.

Making Opaque Coloured Glass.—Opaque glass or enamel may be made by adding white insoluble substances to the ordinary flint or soda glass while it is in a melted condition. Bone phosphate or bone ash and barytes are most commonly used, but cryolite, white arsenic, and oxide of antimony are also employed. To render the glass dull, add to it as much as possible of either bone ash or barytes consistent with proper working and to keep the temperature high while it is stirred into the glass. The colours used are the same as for transparent glass, but more colouring matter is required to give intensity on the white base. For blues, cobalt oxide, smalt, or black oxide of copper are employed; for violet, oxide of manganese; for ruby, oxide of gold, suboxide of copper; for emerald green, copper oxide and oxide of iron, chromium oxide (chrome green); for yellow, uranium oxide, oxide of antimony, etc.

Ink-pad for Rubber Stamp.—To make a pad, cut from the lid of a cigar-box a piece of wood of the desired size. Upon this place several thicknesses of sheet-cotton cut to size. A stretch of fine woollen cloth and a top or surface of linen (a piece of an old handkerchief is excellent) is now put on. The two latter coats must be long enough to come well over the wood round the edges. Finally, tack on a binding of leather or tin. If a lid of a tin is handy, it is a good plan to make the pad to fit into it.

Making Painters' Knotting.—To make a gallon of knotting, as used for painting knots in new woodwork, ¾ lb. of powdered shellac is dissolved in 1½ gal. of methylated spirit; to do this, place it in a warm place, and frequently agitate it. Made this way, it will require shaking up before being used. This is the patent knotting of commerce, to which, however, something is added to keep the shellac in solution. It will not pay to make it, patent knotting being much superior. Where patent knotting is not available, French polish will answer the purpose of stopping-out the knots.

Length and Weight of Clock Pendulums.—There is no rule as to the weight of a clock pendulum; it is regulated according to the quality of clock. The best clocks carry the heaviest pendulums. Weight does not affect the time of vibration; that depends solely on the length. There is no formula for determining the friction or resistance to the air of a pendulum. To find the length of a pendulum for any given clock, first find the number of vibrations it is required to make in one minute, and then find the length of a pendulum making that number either from a table or by calculation. To find the required number of vibrations per minute, multiply together the numbers of the teeth in the centre wheel, third wheel, and 'scape wheel. Divide this by the numbers of the third pinion and 'scape pinion and 30. Thus, suppose the centre wheel is 64, third wheel 60, pinion 8, 'scape wheel 30, pinion 8, then

$$\frac{64 \times 60 \times 30}{8 \times 8 \times 30} = 60 = \text{number of vibrations per minute.}$$

To find the length of the pendulum making this number of vibrations per minute, divide 375·4 by the number and square the result. Thus $\frac{375{\cdot}4}{60} = 6{\cdot}26$; this squared = 39·18, which is approximately the length of the seconds pendulum in England.

Pipes Required to Heat Drying-room by Steam.—The quantity of pipe required depends on the pressure of steam available. With a low pressure, say 10 lb. per square inch, to obtain 150° Fah. 150 sq. ft. surface of steam pipe per 1,000 cub. ft. of space will be wanted. The room has just over 10,000 cub. ft. of space in it, and therefore requires 1,500 sq. ft. of heating surface, or, say, 2,850 ft. of 2-in. pipe. This is supposing the ventilation to be free. With high-pressure steam, considerably less pipe will suffice. A single 2-in. pipe all round would scarcely suffice to heat the room 55° without the full degree of ventilation that is needed in drying-rooms. Wrought-iron pipe should be used.

Dyeing Light Cloth Black.—Put 10 lb. of logwood and 3 lb. of bruised galls in 3 gal. of water; boil for two hours, and strain. Place the coat in the dye, and allow it to remain for half an hour. Take it out, and add about 2 lb. of copperas. Replace the garment, and boil till the dye has thoroughly impregnated it; the time this will take depends on, among other things, the quality and original colour of the coat. Remove it, and hang up for an hour; then rinse it twice, or three times, in cold or slightly warmed water, and dry. Sometimes a garment requires a second or a third dipping. Finish by pressing into shape. Common or old cloth will not stand much boiling, and pure woollen goods have to be treated with extreme care.

How to Preserve Blown Eggs.—To prevent birds' eggs cracking or crumbling after they are blown, well rinse them out with corrosive sublimate dissolved in spirit of wine (a few grains to the ounce); this is a deadly poison. Insert a small quantity into the egg by means of a glass egg-blower with a bulb, then shake the egg so that the solution comes into contact with all the inside skin. Now draw the solution out of the egg by the blower, and return it to the bottle. Now place the egg with the hole resting upon blotting-paper, so that the last drop or two may be drawn out, and finally cover the hole with a small piece of gummed paper. Water containing a few drops of oil of cloves may be used in place of the sublimate if desired.

Concrete to Cover a Brick-paved Floor.—The materials used should be broken bricks, clean sharp sand, and Portland cement, in the proportions of 6 parts aggregate to 1 part cement. An area 16 ft. by 14 ft. by 2 in. contains 34 cub. ft., or about 1¼ cub. yd. The quantities required will be about 1 cub. yd. of broken bricks of the size of a walnut, 1 cub. yd. of sand, and ¼ cub. yd. of cement, or say about 7 cwt. These materials should be well mixed together in a dry state, a minimum quantity of water applied from a water-can with a rose nozzle, and carefully laid to the desired level, being worked with a trowel until the cement creams on the surface and the whole is even. Only a small quantity should be wetted at one time, and before a start is made the existing brick floor should be well brushed with a stiff brush, until all dirt, moss, etc., is entirely removed and the bricks are clean.

Cream-coloured Paint for Table Oilcloths.—For a paint for table oilcloths, try white lead or zinc white ground in oil, with 4 oz. of patent driers to the pound, and enough boiled linseed oil to make it flow. This paint should be applied in a warm room and dried rapidly while hung in a room heated by flues running along the floor. The cloth should previously be coated either with a thick boiled starch or with glue size.

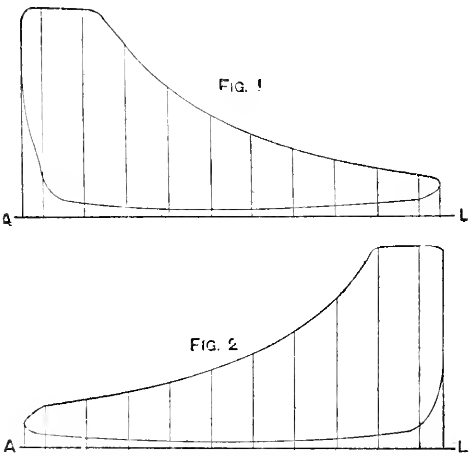
How to Make Sarsaparilla Beer.—Dissolve 1½ oz. of compound extract of sarsaparilla in 1 gal. of hot water, and when the solution is complete stir in 2 lb. of moist sugar. When the liquid is lukewarm, stir in a wineglassful of brewer's yeast and keep in a warm place overnight. Next day, skim off the yeast, strain the liquid, and bottle; tie down the corks, and leave for a week to become brisk. Instead of the extract, ½ lb. of sliced sarsaparilla root may be used, but this will have to be boiled with the water; 1 oz. of liquorice root and ½ oz. of aniseed added to the beer are considered by some an improvement.

Ebonising Pine.—To ebonise pine, take 1 gal. of water, 1 lb. of logwood chips, ½ lb. of copperas, ½ lb. of extract of logwood, 2 oz. of indigo blue, and 2 oz. of lampblack. Put into an old iron pot and boil slowly. When cold, strain through canvas, then add ¼ oz. of powdered nut galls. Or take 1 gal. of vinegar, 2 lb. of extract of logwood ½ lb. of green copperas, 2 oz. of China blue, and 2 oz. of nut galls. Boil over a slow fire. Give at least two coats with an old brush. When dry, intensify the black by brushing over with iron solution, made by steeping a good handful of iron filings or rusty nails in ½ pt. of vinegar; smooth down with glasspaper, then fill in the grain with a filler made of finely crushed whiting, lampblack and turps made into a stiff paste; finish with polish—to make which add to 1 pt. of methylated spirit 4 oz. to 6 oz. of best orange shellac and ½ oz. of black aniline spirit dye.

White Ground for Drawing Boards.—To obtain a white ground on drawing boards so that drawings made with charcoal and coloured chalks may be easily rubbed out, mix dry white lead to a stiff paste with gum arabic dissolved in water; add water till it works easily, like paint. When applying it, either stipple it with a hog-hair brush or cross and re-cross it till no brush marks are seen. A little of the white should first be tried on the corner of the board. Let it dry, then rub the fingers over it. If it rubs off on the fingers, add more gum; if it shines, there is too much gum. To dissolve the gum, saturate it with water and stand in a warm place.

Matt Surface on Photographic Prints.—To obtain a matt surface on photographic prints, matt P.O.P. should be used, this giving the finest results. But a matt surface can be given to an ordinary glazed print by squeegeeing it on to the rough side of a piece of ground glass, the mode of procedure being the same as that for producing a highly glazed surface on ordinary glazed P.O.P., substituting ground glass for the ordinary glass or other polished surface.

Determining Power of Engine from Indicator Diagrams.—To calculate the horse-power of an engine from diagrams, each diagram should be marked off, as shown, by ten lines perpendicular to the atmospheric line A L. The extremities of the diagram are marked on the line A L and the distance between divided into twenty equal parts, perpendicular lines being erected at the first division, third division, fifth division, and so on. The diagram cuts each of these lines in two points, and the distance between these points should be measured to obtain the effective pressure shown by the card at that line. This, however, is not the effective pressure on the piston at that point in the stroke; to obtain this the two cards, front and back, must be superposed, and the back pressure shown on one deducted from the forward pressure shown on the other. This, however, has no effect in the mean pressure as obtained below. The pressure as obtained from the diagram depends on the spring used. On cards with which a $\frac{1}{40}$ spring is used a length of 1 in. shows a pressure of 40 lb. per square inch; so that a length of

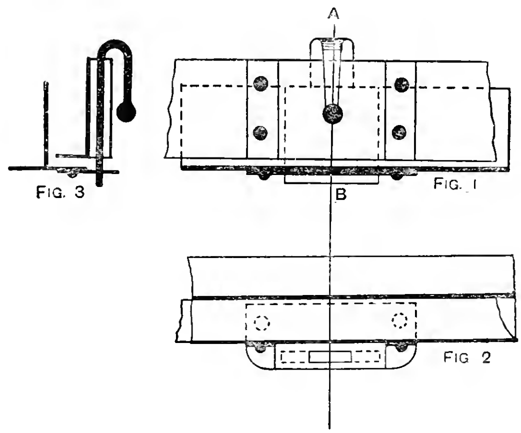


Determining Power of Engine from Indicator Diagrams.

1⅝ in. on the diagram would indicate a pressure of 1⅝ × 40 = 65 lb. per square inch. Owing to reduction, the actual scale of the illustrations is ½, or 1 in. = 80 lb. per square inch. Measured in this way, the pressures are, commencing from the left in Fig. 1, 68, 80, 60, 50, 40, 32½, 25, 18½, 15, and 10 lb. per square inch, and, in Fig. 2, 10½, 15, 20, 25, 30, 35, 45, 55½, 77½, and 72½. The mean of each of these is their sum divided by ten. Thus the mean pressure shown by Fig. 1 is $\frac{399}{10} = 39{\cdot}9$ lb. per square inch, and by Fig. 2 is $\frac{386}{10} = 38{\cdot}6$ lb. per square inch. The mean pressure during the two strokes may therefore be taken at $\frac{39{\cdot}9 + 38{\cdot}6}{2} = 39{\cdot}25$ lb. per square inch. The horse-power may now be determined.

Flat-flame and Bunsen Gas Burners Compared.—Comparing the heat given off by gas burnt in an ordinary gas-burner and that burnt in a Bunsen burner, Professor Lewes states that a luminous flat-flame burner gives a temperature of 2,462° F., and an ordinary Bunsen flame a temperature of 2,732° F., while by increasing the quantity of air until the flame is on the point of flashing down the tube the temperature rises to 2,966° F.; in ten experiments the amount of gas consumed is not stated. A Bunsen burner consuming 4 cub. ft. per hour will require about 36 cub. ft. of air per hour, while the air would be contaminated to the same extent by both descriptions of burner, since the total amount of gas burnt and consequently the products of combustion given off would be the same in both cases. When the gas is mixed with too much air it forms an explosive mixture. With regard to the proportioning of the gas and air supplies of Bunsen burners, the information on this point is mainly due to the labours of Mr. T. Fletcher, F.C.S., the well-known gas-stove maker of Warrington. In a paper read before a meeting of the Gas Institute in 1883, Mr. Fletcher states "that the mixing-tube [of a Bunsen burner] if horizontal should not be less in length than four and a half times or more than six times its diameter." With regard to the diameter of the mixing-tube, "with large flames, given a certain size of gas jet, the diameter of the mixing-tube should not be less than ten times as great." "Given a certain area of tube delivering a combustible mixture, the outlet for this mixture must be neither more nor less than the size of the tube." "The variation from the rule, however, must be a matter of experience with each form of burner. There is also the fact that with small divided flames it is not necessary to mix so large a proportion of air, as each flame will take up air on its external surface; but in this case the flames are longer, hollow, and of lower temperature. As a matter of actual practice, where a burner is used which gives a number of separate flames or jets the diameter of the mixing tube does not need to exceed eight times the diameter of the gas jet, the remainder of the air required being taken up by the surfaces of the flames." It will be seen from the foregoing that it is advisable to regulate the air openings according to the quantity of gas passing.

Catch for Fastening Door of Street Lamp.—The diagrams show a catch suitable for a large lamp. Fig. 1 is a front elevation of the angle iron

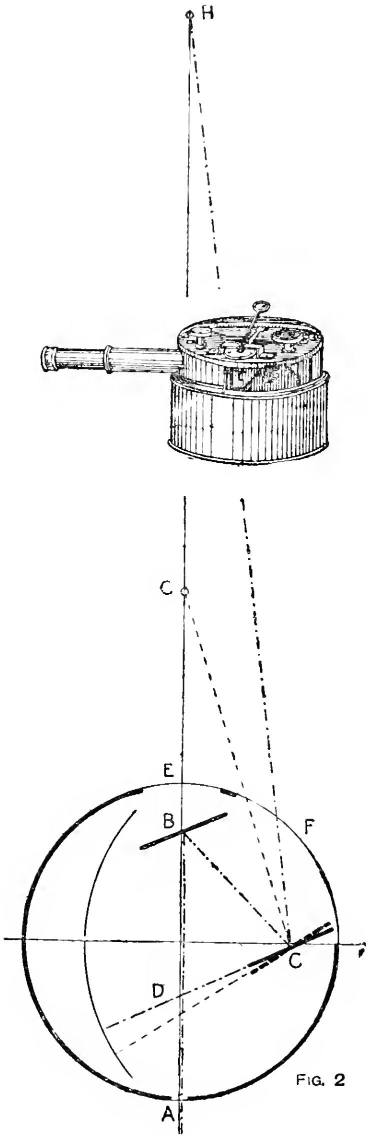


Catch for Fastening Door of Street Lamp.

forming the bottom of the door, with a small rectangular box riveted upon it, in which a flat bolt is arranged, so as to slide up or down. Fig. 2 is a plan of the T and angle iron, box with slot in top and opening at bottom, and also an iron plate riveted on the underneath side of T-iron, a slot being cut in this for the bolt to slip into to fasten the door. Fig. 3 is a section on the line A B, showing the position of bolt in box, and projecting plate on T-iron with slot for bolt to enter.

Use of the Box Sextant in Surveying.—The box sextant is an instrument about 3 in. in diameter, to be held in the hand, for ascertaining approximate angles between any given stations. It is made with or without a telescope, and is in general appearance like Fig. 1. An enlarged diagrammatic plan is shown in Fig. 2, where A is the sight hole of the telescope; B is a fixed glass, the lower half silvered and the upper half plain; C is a mirror attached to the same pivot as the vernier arm D. The side of the case is open at E and F to admit the rays of light from the observed objects. The required angles may be between station poles, church spires, or any other definite lines or points. Suppose a single pole be looked at, the angle indicated should be 0° or zero; whether it will actually be so or not depends upon circumstances which the following remarks will explain. Suppose a pole to be fixed at G, which, bearing in mind the scale, would be abnormally close, it can be seen through the clear part of the glass at B on applying the eye to the sight hole at A. At the same time the rays of light from the pole G will be streaming in all directions, and some of them will pass along the dotted line direct to the mirror C, and, when the vernier arm is placed in the position shown by the dotted line, the rays of light will be reflected to the silvered part of the glass B, and from thence to the eye at A, the appearance being as of one continuous pole

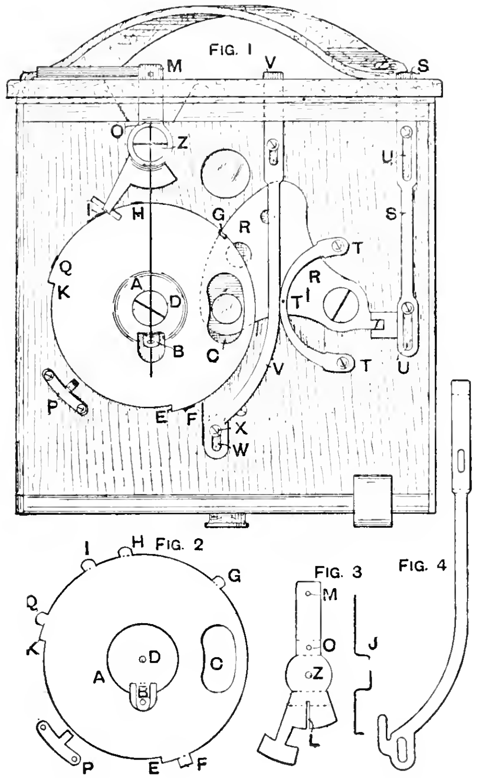
down the two parts of the glass. If the vernier be now examined, it will be seen that the broad arrow falls short of the zero of the scale owing to what may be called the width of base line of the instrument. If the pole be placed farther off as at H, the rays of light following the stroke-and-dot line will require the vernier arm to be shifted rather nearer the zero of the scale; but until the pole is at a distance of two chains from the observer there will be a similar error of less and less



How to Use the Box Sextant.

amount. Between two chains distance and an infinite distance the rays of light from the pole to B and C are now so nearly parallel that the error is under one minute of arc, so that the instrument can be used without difficulty under those conditions. It is usually adjusted by sighting it to the sun, which should appear through the smoked glass as a perfect sphere in whatever way the sextant may be held when the vernier is at zero. When an angle is to be taken at one station and between two others, the nearer station should be viewed through the plain glass, so that the sextant may need to be held upside down. When the angle to be read exceeds 90°, an intermediate pole should be set up and the angles taken in two portions, as in viewing large angles the mirror C is moved so far round that its reflection, and that of the image it carries, is viewed almost edgeways in the mirror at B. The vernier arm is moved by means of a milled head screw on the top of the case. It should be noted that the box sextant only gives angles in the plane of the instrument, so that if the stations observed are not on the same level, the angle given will be the direct angle between them, and not the horizontal angle such as would be given by a theodolite.

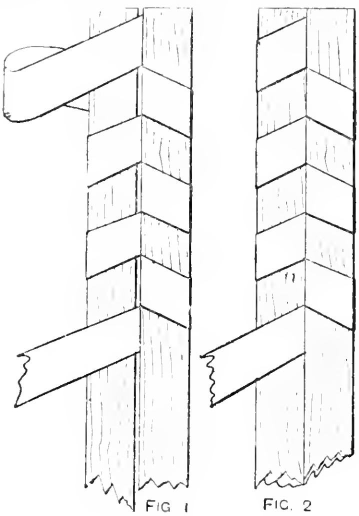
How to Make an Everset Photographic Shutter.—A shutter suitable for use with a single lens at the diaphragm (as employed in the bull's-eye kodak, and shown complete at Fig. 1) may be made as follows: Cut thin brass or zinc to the shape shown by Fig. 2. The centre part A is punched in, and upon it the shutter or circle turns. The projections are turned up, and the part B, after being pierced and cut round, is turned up on the dotted line. Now cut the releasing arm (Fig. 3) in the metal, bending in the dotted lines to the form J. Note the slot L. Around the screw or pin fitting the screw hole M



How to Make an Everset Photographic Shutter.

goes one end of the steel wire shown in Fig. 1, which passes from it through O across L, and very loosely through the large hole in B. The fixing of the shutter is shown in Fig. 1, and when attached to the camera front by a broad-headed screw through D and another at Z, the catch P is fixed in the correct position. Through the arm the wire pulls the shutter round when out of the way of projection Q or G. As the shutter stands away from the front, space is left for the diaphragms between it and the lens. These consist of three holes formed in the triangular plate R worked by the arm S and guided by the semicircular piece T. The position of the first and last diaphragm is governed by the slot U, but the middle one is centred with the lens by having a dent T^1 in R, which receives a similar projection (the under part of the dent) in T. For time exposures the arm V (Fig. 1), also shown at Fig. 4, is lifted, the slot W passing around the screw X, and when raised it meets the projection F, and, on pressing the release in the opposite direction, it returns. Projections H and I then come into use. The method of bending the arm may be gathered from Fig. 1, which shows the shutter set for an instantaneous exposure, it having travelled halfway.

Method of Hinging Screen Frames.—It is often difficult to decide which is the best and cheapest way of hanging screen frames. A screen should be hinged so that it will close both ways, but the expense of the double folding joints made specially for that purpose is too great to admit of their frequent use. The following describes a cheap, simple, and efficient substitute. Assuming that the frames are ready for hanging, and that the screen consists of four frames, there will be three separate hangings, which will require six laths laced together in pairs, as shown. The laths should be sawn out of a ½-in. board the full height of the frames, and if the thickness of them is ⅞ in., the laths should be ⅛ in. wider, to allow the screen to close flat together without any strain. Gauge and plane up the laths both in width and thickness, neatly finish off the ends so that all of them are exactly the same length, and, to prevent the sharp edges cutting the tapes, rub them well off with sandpaper. They are now ready for painting, staining, varnishing, or polishing, as may be preferred. When they are dry, proceed to put on the tape, which may be got in various colours from ¾ in. to 1 in. wide: about 3 yd. will be required for each pair of laths. Mattress binding is good; being made of linen it does not stretch. Begin by tacking the end of the tape to the top end and under side of one of the laths in an oblique direction; lay the two laths together, pass the tape up between them from the under side, and lace them together rather loosely, over and under, first left, then right, and leaving a loop as shown at Fig. 1. When sufficient turns have been put on to reach the bottom, begin again at the top to pull the laths tight together, turn by turn, and regulate the distances; fasten the end off at the bottom to the underside, as before. It is of great advantage to hold the two laths edge to edge in the bench-screw while pulling the tape tight, as it leaves both hands at liberty to manipulate it. Proceed now to hang the frames together; bore four holes in each lath, at equal distances between the tapes, neatly countersink for screw-heads, and screw them to the edges of the frames. This joint has a very pleasing effect if it is neatly done and the tape is made to harmonise with the material on the frames. It is very durable, draught- and sight-proof, and can, if necessary, be renewed at a very small cost of time and money.

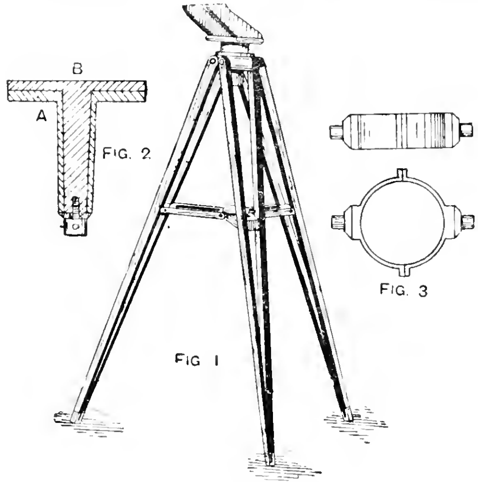


Method of Hinging Screen Frames.

Transferring Photographs to China, etc.—To finish off a photograph so that it will look like china without enamelling, several simple methods of transferring are available. Among these is the use of Eastman Transferrotype paper, and various makes of stripping P.O.P., which are to be had of photographic dealers. Ordinary P.O.P. may also be used, but the result is somewhat uncertain. In the case of ordinary P.O.P., thoroughly wash the article to which the photograph is to be transferred, then coat it with a weak solution consisting of gelatine 10 gr., water 1 oz., and bichromate of potash 5 gr. Crush the bichromate, and add the gelatine last. Expose the coated side to the light, and wash for some hours. Take a very darkly printed proof finished and dried, but not alumed, soak it in cold water, and then place on the article to be decorated; squeegee the print thoroughly into contact, and dry. Now pour on hot water till the print blisters badly, when the paper may be stripped away. If the water is too hot, the gelatine will melt. Great care must be taken not to move the print, which should be laid flat; and when dry a coat of copal varnish should be applied, and the article baked. It will then stand careful washing.

Boring a Railway Tunnel from Both Ends.—In the construction of railway tunnels it is usual to work from both ends, and sometimes from intermediate points also. The line of route is laid out on the surface to facilitate observations underground; but if this is impossible the extreme points have to be connected by accurate trigonometrical surveys and exact levels, so that their relative positions are precisely known. The centre line at formation level is then accurately set out by theodolites and standard chains, a smaller heading being driven in advance of the main tunnel, so that (apart from facilities of construction) in the event of a slight error in meeting the heading from the other end, the directions may be adjusted.

Garden Tripod Stand for Telescope.—A cheap equatorial stand that does not require much lathe work in its construction must have an axis on which to

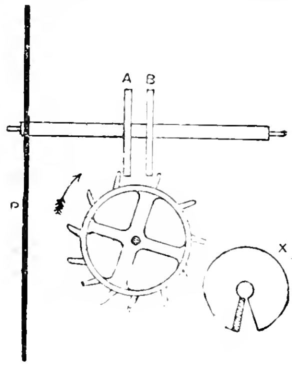


Garden Tripod Stand for Telescope.

rotate, to provide the horizontal motion; the vertical motion being provided by a metal clasp having two trunnions, which rotate on wooden uprights provided with V-shaped bearings. This mounting is supported by a wooden tripod stand similar to the ordinary camera stand, though, of course, more substantial and rigid. It can therefore be used either indoors at an open window or in the garden. In the tripod shown in Fig. 1 the three legs are bolted to a wooden base and provided with three cheeks for the purpose. Under the base, about halfway down and connecting the three legs together, is a sort of a double joint, which folds upward when the stand is not in use. When open, this drops and keeps the legs stationary. Above the base, and glued and screwed to it, is a circular, cylindrically shaped block having a hole through its centre to receive a female cone of metal. A recess in the block receives the shoulder at the top, which is then screwed down to the block. This cone is shown in section at A (Fig. 2). A cone, shown at B, is similarly screwed to the oblong stage of wood above the block, to which the uprights are screwed. The two centres are ground together, and, when fitted accurately, are held together by a screw and washer at the ends. The uprights, shaped as in the illustration, carry the clasp by its trunnions, the clasp being screwed around the body tube of the telescope. The clasp is a metal casting about 2½ in. deep, with two circular trunnions and two rectangular wings. This is shown in elevation and plan at Fig. 3. When the hole has been turned to fit the tube, and the trunnions turned exactly equal to each other in diameter and fitted between the uprights and to the V's on them, the rectangular wings are drilled for four screws, two at each wing. The ring is then severed into two halves, the saw cutting through the wings. Some blotting paper is then pasted in the curves of each half, to prevent the disfigurement of the lacquer work on the body tube, and, when dry, the clasp is screwed together around the tube. In this way the two horizontal and the vertical motions are supplied.

Time for Photographic Exposures.—All photographic exposures being somewhat in the nature of an experiment, because of the ever-varying conditions of the atmosphere, it is possible only to give approximate times. Over-exposed plates may be corrected by careful development; but a very much under-exposed plate is past remedy, and a slow plate is more easily dealt with than a fast one. As a rough guide to a beginner, exposure meters may be of service, but, if followed too slavishly, they may prove worse than useless. The following is the minimum exposure for June, 11 a.m. to 1 p.m.:—Clouds, [illegible] sec.; sea and sky, [illegible] sec.; open landscape (distant objects only), [illegible] sec.; buildings (well illuminated), [illegible] sec.; groups (light dresses), [illegible] sec.; groups (dark and heavy contrast), 1 sec. It is impossible to classify interiors as light and dark to be of any use. The only practical plan is to make a trial exposure and develop the plate. If it is impossible to develop a trial plate, make several exposures of different lengths. In all exposures the colour of the light and the degree of contrast in the subject and that required in the picture must be taken into account. It may here be mentioned that one would hardly attempt clouds, sea, or sky in the middle of the day. Bear in mind the old rule, "Expose for the shadows, and let the lights take care of themselves."

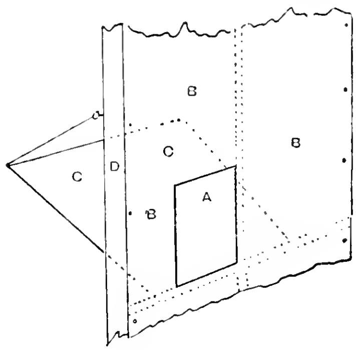
Clockwork Metronome.—To make a clockwork metronome, a pendulum must be employed. The usual arrangement is to have a short lead bob pendulum, about 3 in. long, pivoted upon an arbor. The rod is extended upwards, and this upper portion is fitted with a sliding weight to adjust the speed. The higher the top weight is raised the slower the pendulum goes. The escapement is shown in the accompanying sketch. The 'scape wheel teeth are straight pins, and they rest upon two flat steel discs fixed on the pendulum arbor. These discs are cut, and the edges bevelled off, to give the impulse alternately in each direction. Thus, one of the pins of the 'scape wheel falls upon the face of disc A and, passing the bevelled edge, gives the pendulum an impulse to the right and falls upon the second disc B. As the pendulum returns, this tooth gives impulse, by means of the bevel on B, in the opposite direction to A, and the next 'scape tooth falls upon A, and so on. An American drum-clock train will do. The 'scape wheel must be taken away, and the next wheel before it converted into a 'scape wheel by breaking out some of the teeth, leaving one in every three, and bending them forward a little.



Clockwork Metronome.

Protecting Exposed Water Mains from Frost.—There are incorrect ideas as to how a bad heat-conducting material protects pipes from frost. Water absorbs and holds heat, but the heat is readily dissipated, or radiated, or becomes absorbed by cold air or substances with which it comes in contact, the consequence being that its temperature is reduced below 32 and the water becomes ice. The purpose of a bad heat-conducting material is to form a barrier to this heat transference, so that should the water be, say, 50, the air and general surroundings can be much lower in temperature without reducing the heat of the water in any marked degree. The covering, therefore, does not afford any heat whatever, but prevents heat passing through it. Coverings, however, to be as effective as this would require to be of materials which are perfect non-conductors of heat, and this is not as yet possible. There are some very effective bad conductors, almost non-conductors, and the two best are undoubtedly hair felt and silicate cotton (slag wool). Both vary in effectiveness according to the thickness of the covering. If hair felt is used it can be ½ in., but [illegible] in. is better for good work. It should be cut in strips and be wound on the pipes soundly; but it is best not to bind it on too tightly afterwards. It should be secure, but not compressed. The silicate cotton is usually a loose material, and requires to be placed in a casing. It can, however, be obtained sewn on to canvas. Probably any one of the patent compositions used for jacketing steam boilers would answer the purpose. The coating should afterwards be lagged with narrow boards secured with iron belts or bands, or be covered with canvas and painted, tarred, or otherwise protected from decay through damp or by atmospheric corrosion.

Simple Method of Copying Negatives for Lantern Slides.—The following is a simple way to make lantern slides by reduction, the ordinary camera and lens being used, supported preferably on a table: First make a carrier to hold the lantern plate in the dark slide by tongueing together, to form a frame, two pieces of [illegible]-in. wood [illegible] in. by [illegible] in., and two similar pieces 6½ in. by ¾ in. Rebate the inner and outer edges on opposite sides [illegible] in. Thoroughly clean a window pane and place the negative for reduction (A) film towards the camera in one corner. Fasten in position safely with two drawing pins. Outside the window D suspend at an angle of 45°, to act as a reflector (C), a sheet of white cardboard at least four times the size of the negative. Fasten at the bottom and attach string to the two top corners. In a large sheet of brown paper B cut a hole A just large enough to expose the whole or the desired portion of the negative. Pin this up and fasten curtains across the top of the window. Build the camera up level with the boxes, focus very sharp, and expose as usual. The centre of the plate must exactly coincide with the centre of the negative, and the corners should all be equidistant, otherwise the lines will be distorted. No special lens is required. When a clear view of the sky is obtainable, a lidless box, having an opening in the bottom capable of receiving the negative and corner pieces to prevent it falling through, may be attached to one end of a board; at the other end is the camera. The board at the box end is fastened to the window sash with eyes; the other end is suspended with string so that the negative points to the clear sky and even illumination is ensured.



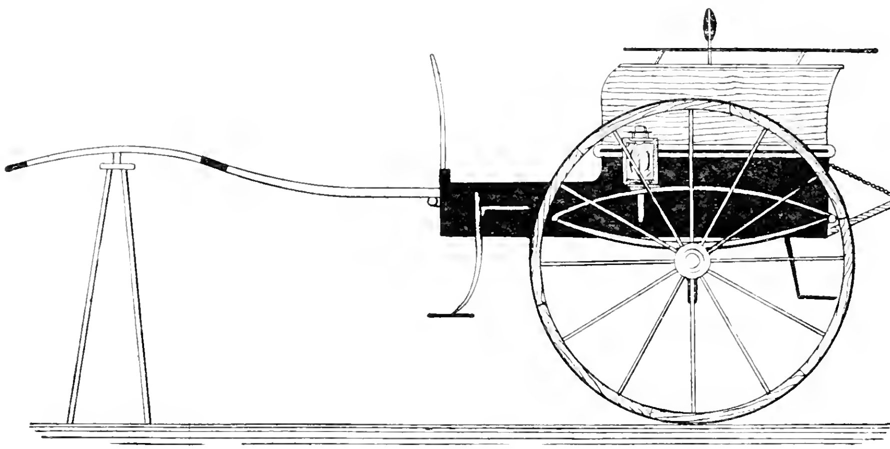
Apparatus for Making Lantern Slides.

Making Wax Candles.—Wax candles are made in machines each capable of moulding fifty or one hundred candles at one time. The machine is simply a framework holding a large tray having a number of circular holes. Under each of these holes hangs a candle mould with the point downwards. The wicks are wound upon bobbins below, drawn through the points of the moulds, and then stretched tight by fixing to a frame above so that they pass up the centres of the moulds. Surrounding the moulds is a trough. The molten wax is poured into the tray, from which it falls into the moulds. Cold water is then run into the trough, and the wax immediately solidifies. The excess of wax in the tray is removed by a scraper, and the frame carrying the wicks is raised so that all the candles are drawn out of the moulds. The wicks are then cut and the process repeated. The waxes used are paraffin wax, composite (paraffin wax with 5 to 15 per cent. stearic acid), cerasin, etc.

Colouring a Malacca Cane.—To colour a malacca cane, mix some spirit aniline dye in thin spirit varnish. Bismarck brown yields a rich red; yellow may be obtained in various shades, but must be very strong in order to gain a good colour, unless the upper surface of the cane is removed by the aid of No. 1 glasspaper. The cane may be finished with clear spirit varnish, though better wearing results would be gained by a thin, even coat of best quality coach varnish.

Properties and Use of Picric Acid. Picric acid is formed by the action of nitric acid upon phenol (carbolic acid). Picric acid is a pale yellow crystalline substance sometimes used in dyeing, as it yields a fine pale yellow upon silk. It is principally used in the preparation of some of the "high" explosives. It does not explode by applying a light or by friction, but when a strong detonating cap is exploded in a cartridge of picric acid, the latter is caused to explode with terrific violence. The combinations of picric acid with soda and potash are amongst the most powerful explosives, but as they sometimes explode spontaneously, they are rarely used.

Small Cart for Pony.—A cart suitable for a pony from 11 to 12 hands high is shown below. The length of the body is 4 ft. at the bottom and 2 ft. 6 in. on the seat. The bottom panel sides are 10½ in. deep under the seat and 7 in. at the front. The front board is 8 in. deep. The top sides are 1 ft. deep, and are bent over sharp at the top, each being fastened with two half-round irons in addition to being screwed from outside to pieces that the seat slides on, which, with a cross-bar, are of birch or oak 1 in. thick and 3¼ in. wide before being



Small Cart for Pony.

dressed. These bent sides can be made of ⅜-in. walnut finished in plain varnish, and give a nice contrast to the black japan on the bottom panels; a piece of wide wood bead, having a strip of plated bead fastened along the centre, going over all. The bottom of the body is 3 ft. wide, and may be made either quite square or, if preferred, spread out each side 1 in., when 2 ft. 10 in. will be wide enough for the bottom. The bottom boards are 1-in. deal. The simplest way of putting the cart together is to screw a batten along inside either side and nail the boards to these, having a good bar of 1-in. ash at back and front, and underneath all is nailed a couple of pieces of hoop-iron. The elliptic springs are 3 ft. long, with four plates 1¼ in. wide. They are fastened to the body with angle-irons and blocks 1 in. deep by 4½ in. long. The 1¼-in. axle is cranked 4½ in. deep. The dash is 22 in. long and 15 in. high; wings, 6 in. wide, ⅜ in. thick, and 2 ft. 6 in. long; wheels, 3 ft. 6 in. high; stocks, 7 in. by 5½ in. diameter. There are twelve 1⅜-in. spokes; felloes finish 1⅝ in. wide by 1½ in. deep; tyres, 1¼ in. wide. The shafts are 4 ft. 10 in. long in front of splinter-bar, and 1 ft. 8 in. wide at tugs, which are 14 in. from points; they go inside the body, and are fastened in rubber bearings at the front and with a long cross spring at the back. If required rather stronger for rougher usage, have the stocks 6 in. or 6½ in. diameter, and spokes ⅛ in. and felloes ¼ in. larger than the measures given. In this case the springs might have another plate added with advantage.

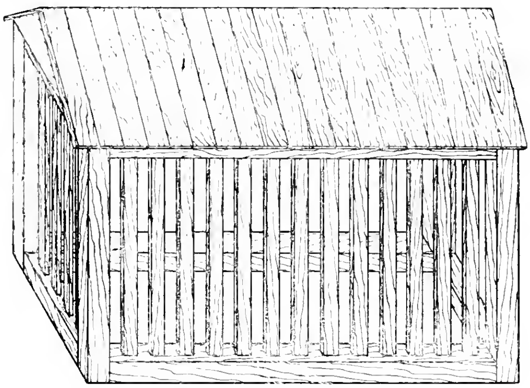
Kallitype Process in Photography.—The Kallitype process of printing is the subject of a patent. It consists of first coating any fairly pure paper with a mixture of silver nitrate and ferric oxalate. The ferric oxalate is reduced to the ferrous state by the action of light, and thereby reduces the silver in contact with it, thus forming a visible image, which is simultaneously developed and toned, and afterwards fixed. Dissolve 70 gr. of ferric oxalate in 1 oz. of distilled water, and add 15 gr. of silver nitrate. Brush this solution with a sponge or tuft of cotton wool well and evenly over the surface of the paper, and allow to dry; then place the paper in contact with a bright negative in the printing frame, and expose fully to a good light. Immerse for from fifteen minutes to half an hour in a solution containing 25 gr. of Rochelle salt and 25 gr. of borax to 1 oz. of water. This gives a black image. By decreasing the borax to 9 gr. and adding three drops of hydrochloric acid, a sepia picture is obtained. Transfer for ten minutes to a 1-per cent. solution of ammonia, then wash for half an hour, and the print is finished. Ferric oxalate may be made as follows: Add to 2 oz. of ammonia iron alum, in a 20 oz. measure, 1 oz. of strongest liquor ammonia with 1 oz. of distilled water. Stir well and allow the precipitate to fall. Wash by decantation till alkalinity disappears; then add 1 oz. of crystallised oxalic acid, and make up to the desired strength with distilled water. Ferric oxalate purchased of a chemist should be tested by adding to a solution of it a few drops of a solution of potassium ferricyanide, when, if it has changed to the ferrous state, it will throw down a dense precipitate of Prussian blue.

Waterproofing Canvas.—To make "chemical" canvas prepare two baths, one containing 1 lb. of yellow soap in a gallon of warm water, the other containing 1 lb. of alum in a gallon of warm water. Pass the canvas through the warm soap solution, and then through the alum solution. To obtain a very thick coat, put the canvas several times alternately through the two baths. Old canvas may be treated in the same way as new.

Advantages of Copper Range Boilers.—The lasting quality of a copper range boiler as compared with an iron one, when used to heat hard water, is not worth the extra cost. The incrusted deposit that is the usual cause of boilers becoming destroyed in hard-water districts will make the copper plate fracture nearly as soon as it will the iron. An idea is prevalent that by using a copper boiler the accumulation of deposit from hard water, and subsequent fracture of the boiler, are prevented or avoided, but this supposition is groundless: a copper boiler is at no real advantage in heating hard water. In soft-water districts copper is largely used because iron will not long withstand the active rusting process that the soft water sets up. In such places copper boilers, copper cylinders, and lead, copper, or tin-lined pipes have to be used. The thickness of the plate of copper boilers varies, for copper being such an excellent wearing material (when water is in close contact on one side of it), the plate need not be thick, and ⅛-in. plate would be ample if it were not that copper is soft and cannot withstand heavy water pressure, nor the blows that the cook delivers against the boiler front with the poker. Therefore the usual thickness is $\frac{5}{16}$-in. body, with $\frac{7}{16}$-in. or ½-in. front-plate. If the boiler is large, and the water pressure exceeds, say, 40 ft., then either a thicker body-plate must be used, or brass stay-bolts must be placed across the body-plates. Brass or copper bosses must be brazed around the pipe holes, to allow of a sound joint being made; and, in hard-water districts, it is important to remember to order a manhole large enough to insert the hand for cleaning. A 3-in. hole and a 3-in. plug are usually sent to make the manhole and lid, but this is too small. The cost varies with the market price of copper, but the boilers are usually something under 1s. per lb. Copper boilers, before they get beyond repair, should have a piece dovetailed in and soundly brazed.

Mounting Photographs.—Fill a large hand basin or dish with water, and immerse the photographs in it for a few minutes, allowing them to drain slightly after removal, and then place them with the image downwards on a sheet of glass. Lay over them a few thicknesses of blotting paper and roll out excess of moisture. Now brush over the top one with some Higgins' photo mountant or fresh starch paste, lift it carefully by the corners and lay in position, cover with fluffless blotting paper, and with a squeegee roll gently twice. If the photographs are to be mounted in an album, wet mounting may cause cockling, and in such case an alcoholic solution of gelatine should be used: Nelson's No. 1 gelatine, 1 oz.; water, 3 oz.; glycerine, 2 dr.; methylated alcohol, 10 dr. Dissolve the gelatine in the water, then add the glycerine and alcohol last. In this case the position the print is to occupy is marked on the leaf; and, the print having been dried in contact with glass, a thin coating of solution is run rapidly round the edge of the print or within the line on the leaf with a small brush and the print rolled into contact. It is always advisable for a beginner to gain skill and experience by practising on wasters or spoilt prints.

Crate for Carrying a Pig.—The accompanying drawing is almost self-explanatory. The size of the crate would depend upon the size of the pig, but about 4 ft. 6 in. long by 2 ft. 6 in. wide and 2 ft. 6 in. high will be large enough for any ordinary animal. The framing should be of good yellow deal



Crate for Carrying a Pig.

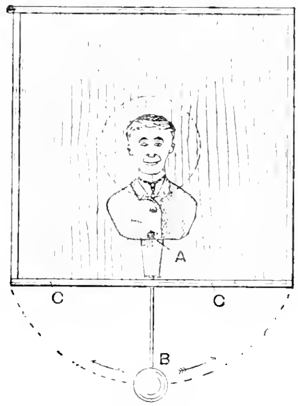
3 in. square, and the laths $2\frac{1}{2}$ in. by $1\frac{1}{4}$ in. The latter can be either mortised into the framing as shown, or the rails can be kept back from the face and the laths nailed on. The roof should be of 1-in. tongued and grooved boarding, and the floor should be formed of $1\frac{1}{4}$-in. boards laid with spaces of about 1 in. between them. One end of the crate should be made to open to form a door for the entrance and egress of the pig. Two small iron wheels, say about 8 in. diameter, can be fixed, one at each side of the crate; a 1-in. wheel should also be mounted in the middle of each end. The crate would thus have four wheels, but would run on the two side ones only; the other wheels would prevent the crate from ploughing into the earth when the pig shifted its position.

Covering a Pulley with Leather.—A cement made as follows may be used with great success, both for covering pulleys with leather and on belt joints before riveting. The leather will tear before coming off, if carefully done. Make an extract by digesting 1 part of coarsely crushed nut-galls with 8 parts of rainwater, let stand for several hours, and filter through linen. Then pour 1 part of cold water over 1 part of best glue, let it stand for twenty-four hours, and heat to make a concentrated glue solution. To use the above, warm the nut gall extract, and coat the leather with it. Warm the pulley, which should be roughened, and coat with the glue. Lay the leather on the warm pulley, press firmly together, binding it tightly with cord.

White Coating for Model Boats.—Most makers of model boats have found that it is practically impossible to give a model a pure white surface by painting it in the ordinary way with zinc or white-lead. After standing a day or two it takes a yellow or maybe a dirty white tinge. If the following directions are carried out in a careful and cleanly way, a pure white surface which will stand the test of time and sunlight will result:—After the model has been thoroughly glasspapered down, give it one coat of paint, made by mixing ordinary white French polish with flake white powder until it has the consistency of skimmed milk. When this first coat has dried quite hard, rub it down with No. 0 glasspaper; dust the model and give it another coat of the same paint; repeat this process at least six times. Then give it another coat, but, instead of smoothing it with glasspaper, rub it down with powdered emery and water, using a piece of hair-felt. Repeat this, and a beautiful white will be the result. Do not varnish it.

Air Vessels on Pumps. The bottle-shaped air vessels are used to produce an even, uniform discharge from the pump, the action of the pump plungers being intermittent. Air is stored inside the vessel, and the water, after having passed through the delivery valve when the vessel is on the delivery pipe, compresses the air. When the plunger makes the suction stroke, the air cushion acts as a spring and delivers the water. A suction air vessel should be used where the length of the suction pipe is great in comparison with the diameter and for high-speed pumps. The contents of the air vessels vary in different makes from three times to ten times the capacity of the pumps.

Grotesque Target for Shooting Gallery. The illustration shows a front elevation of a novel shooting gallery target with the front removed. Make a square box, say 2 ft. square and from 4 in. to 6 in. deep; have a circular hole about 9 in. diameter in the centre of the box. Cut a grotesque head of zinc from 4 in. to 6 in. in diameter; extend the shoulder and neck



Grotesque Target for Shooting Gallery.

downwards a few inches, having a pivot A of wood or iron through the neck, the bearing being at each side of the box, so that the head will be in the centre of the box. Attach a piece of stout wire to the bottom of the neck piece, and, so that it swings as a pendulum in a slot in the bottom C, fasten a piece of lead B to the bottom. A bird or any animal may be made to work the same as the head.

Making Angle Zinc.—To make angle zinc to be used for constructing an aquarium, after cutting the sheet zinc to the required width, mark it deeply with the scriber or cutter along the bending line on the underside. Then place the zinc along the flat side of a beck-iron or the edge of a hatchet-stake, and, keeping the bending line upon the tool edge, press both long edges downwards, commencing at one end and working along the zinc until the opposite end is reached; then smooth down to the angle required with a mallet or dresser.

Pickle for Gun-metal Castings.—The percentage of water to sulphuric acid to be used as a pickle for gun-metal castings depends on the composition of the metal. Try by experiment. A pickle for the outer skin would be 10 of water to 1 of acid; leave in a few hours to remove sand, and finish by dipping in aquafortis and swilling quickly in plenty of water. Dry out in hot sawdust; or dip in hot water and use cold sawdust. In the trade, old dilute aquafortis is used as a pickle for castings, which are left in it overnight and dipped in strong acid afterwards.

Recharging Ink Pad of Typewriter.—A suitable ink may be made by dissolving 1 part of aniline black (soluble in oils) in 6 or 8 parts of oil of cloves by a gentle heat; while still warm, apply it to the pad with a camel-hair brush. Another ink may be prepared by grinding together very carefully 1 part of gas black and 5 parts of oil of cloves; but to make the latter properly, a grinding plant is necessary. If the pad is worn, it is useless trying to treat it.

How to Start a Dynamo.—Before starting a dynamo, examine it carefully to see that the brushes, lubricators, etc., are in order. The machine may then be run at full speed for a short time, with the brushes off, to see that the bearings are in order. It should then be stopped and the brushes adjusted to their places on the commutator. The main switch may then be closed and the dynamo set running, the speed being increased until the voltmeter or a pilot lamp shows that the correct voltage has been reached. Then, as the load comes on, the brushes may be shifted backwards or forwards, as may be necessary, for sparkless commutation.

Retouching Medium for Photographic Negatives.—The simplest retouching medium is made by dissolving about half a teaspoonful of powdered resin in 1 oz. of turpentine. Add the resin a little at a time, shaking well. It will probably take about two days to dissolve, but it should be shaken occasionally. Apply with the ball of the finger, rubbing well with a circular motion until it resists. Take the supply from the top of the cork and not direct from the bottle. Avoid streakiness or the least unevenness. Retouching medium can also be bought ready made of all dealers in photographic requisites.

"Pavodilos" Joint in Flooring.—A sketch of the "Pavodilos" rebated joint as used in floor boards prepared for secret nailing is shown by Fig. 1. It is patented, and the name is registered as a trade mark by the manufacturer of the joint. "Pavodilos" jointed flooring and matching is, however, turned out by other

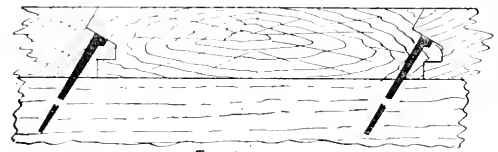


FIG. 1

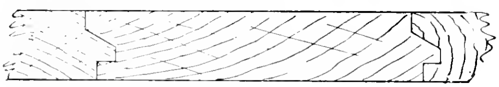


FIG. 2

"Pavodilos" Joint in Flooring.

firms who work under licence; and some specimens are worked as shown by Fig. 2, which, although the second key is lost, may possibly be preferred on account of the danger, when nailing down the flooring jointed as in Fig. 1, of damaging the feather-edge of the board that is being fixed.

Securing Dowelled Work Together.—The holes for dowels should be made exactly opposite each other in each piece forming the joint. Then the dowel should be accurately fitted in. When the work is ready for gluing up, the dowels should be glued in one part of each joint first, then the other part of the joints, dowels, etc., should be glued; the whole should then be quickly cramped up—that is, the joints forced up close. Frequently it will be found advisable to leave the cramps on until the glue has set or become hard.

Composition of Muntz Metal.—Muntz metal consists of 57 parts of copper and 13 of zinc, or 60 of copper and 40 of zinc, or 66 of copper and 34 of zinc.

Determining Contents of Circular Tank.—A rule for finding the contents, in gallons, of circular tanks is as follows: First find the contents in cubic inches and multiply by ·0036, or in cubic feet and multiply by 6·23. The cubic capacity of a circular tank in cubic inches equals the diameter in inches squared (that is, multiplied by itself) multiplied by ·7854 and by the length in inches. For the capacity in cubic feet, take all dimensions in feet. As an example, the contents of a circular tank 4 ft. diameter by 5 ft. high equals $4 \times 4 \times ·7854 \times 5 \times 6·23 = 391$ gal. (roughly).

Proportioning Rooms for Sound.—Wyborn's "Notes for Architects and Draughtsmen" gives the following rules for the proper proportions for a building in order that speaking from platform or pulpit may be distinctly heard all over the room. For concert rooms, etc., height 2, width 3, length 4 or 5. Example:—Free Trade Hall, Manchester; height 52 ft., width 78 ft., length 135 ft. For lecture rooms, etc., height 2, width 4, length 3. Example:—Theatre of Royal Institution: height 30 ft., width 60 ft., length 45 ft. The hearers should not be at a greater distance from the speaker, for convenient hearing, than 50 ft. in front, 30 ft. on each side, and 20 ft. behind. No person should be farther than 70 ft. from the speaker. The greatest number that can hear a speaker conveniently is 2,000, arranged in two tiers. The end opposite the orchestra or speaker should be semicircular, or have the angles rounded. The ceiling should be elliptical or coved, and there should be a hollow space beneath the floor.

Concrete for Foundations.—In gauging up concrete, burnt ballast, with or without clean brick rubbish, will make fair common lime concrete, but for good concrete there should be no burnt ballast, and the brick rubbish should be clean and hard. For cement concrete, stone ballast and hard bricks, broken to pass a 2½ in. ring, would be suitable. One of lime to five of the other materials, or one of cement to seven of the other materials, is an economical proportion. Burnt ballast, like a common place-brick, crumbles on exposure to the weather, and in damp foundations will in course of time go the same way; even in dry foundations it will not bear a heavy load.

Fitting Windsor Chair as Barber's Chair.—The following is a sketch that shows how to convert a windsor chair into a barber's chair. Make two brackets, as in Fig. 1, out of elm or other hard, tough wood, and bore a hole through the centre of one, as indicated by the dotted circle. Screw the solid one to the seat of the chair at the back, and the one with the hole bored in to the back of the top piece of the chair. The plain sides of the brackets must be so fitted that when fixed the two mortises are in a straight line with each other. Now fit a piece of wood about 3 ft. long into the

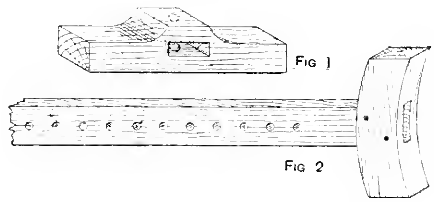


FIG 1

FIG 2

Fitting Windsor Chair as Barber's Chair.

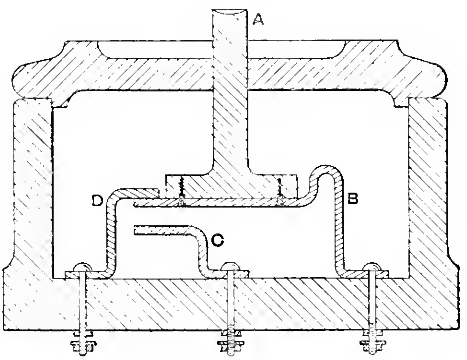
mortises in the brackets, so that it will slide easily up and down. Fix a cross-piece to the top of this, as shown in Fig. 2, and also bore holes up the middle at intervals of 1½ in. To fix the sliding piece at the height required, an iron pin is used; this should be connected with the top bracket by a short length of chain. The cross-piece should be covered and padded.

Jonval Turbine.—This works by pressure, and may be drowned or connected to a suction tube. It is an axial or parallel-flow turbine, the water passing through the motor in directions parallel with the central shaft. The water enters a fixed wheel, and is guided into the movable wheel keyed to the shaft, which rotates on a pivot bearing. To regulate the power of the turbine, a number of the guide passages are closed by a special casting, carrying a segmental rack worked by a worm. The efficiency of the Jonval turbine increases with the load.

Working Celluloid.—To work thin sheet transparent celluloid into different shapes, it is pressed with heat in a hydraulic or other press or mould, and allowed to cool gradually. A French recipe for non-inflammable celluloid consists in dissolving ordinary celluloid in acetone in about the proportion of 25 grammes of celluloid to 250 grammes of acetone, and dissolving pulverised magnesium chloride in alcohol in the proportion of 150 grammes of alcohol to 50 grammes of magesium chloride. Then mix the two solutions so as to obtain finally a pasty mass, containing, say, 20 grammes of the magnesium chloride for each 100 grammes of the celluloid. An uninflammable material, similar to celluloid, was invented in 1896 by Cadoret, of Paris, which he claims to be a substitute for indiarubber, celluloid, leather, oilcloth, linoleum, mother-of-pearl, tortoise-shell, amber, ivory, etc., and which is capable of being moulded, drawn, or made into threads, and in the form of plates, tubes, and cylinders, or soft and silky threads resembling silk in appearance, and can be dyed in various colours. It has another peculiarity—that while the dies or rolls are cold, there is no polish on the surface of the rolled sheet or moulded article, but with heat and pressure the polish of the mould is given to the pressed article. This material, to which the name of "textiloid" has been given, can be made as transparent as glass.

Diminished Twisted Column.—In setting out and working a diminished twisted column for masonry, first set out the column to the extreme diameter of outside of wreath or roll, with the diminish and entasis as in an ordinary column. Having decided how many times the wreath is to encircle the column, set out the spiral to a developed line. If a piece of paper is cut the shape of a right-angled triangle, the height of the perpendicular being equal to the height of the cylinder, the hypothenuse (or long side of the triangle) will generate a curve winding round the cylinder in the form of a spiral. This curve is called the helix, and is the developed line of centre of wreath or roll required. In order to illustrate this more clearly, take two long ribbons of paper cut parallel, one piece being white and the other piece black; wind first, say, the white round the cylinder, leaving a parallel space just sufficient for the black piece, which now wind round the vacant space, touching perfectly each of the edges of the white band. This being done, let the white band represent the roll and the black band the hollow, or vice versâ. This example applies to a cylindrical shaft whose ends form equal parallel circles. In the case of the tapering column the developing of the spiral line will require great nicety in the setting out; and although the band will not be quite parallel, the principle is the same. The shaft is first worked as a plain column to the extreme or outer diameter. The spiral line is then traced round the shaft, and the hollow worked out. Lastly the roll is rounded off, each process being guided by reverses or templates.

Construction of Double-contact Electric Push.—The essential parts are shown in the adjoining illustration. A push A is connected to a spring B. Underneath the push is a smaller spring contact C, and at the side opposite B is another contact D. B, C, and D each have terminals, not necessarily in the form sketched. By these terminals the connections required may be made. In the standing position B and D make contact, but by pressing A the circuit is made by way of B and C.



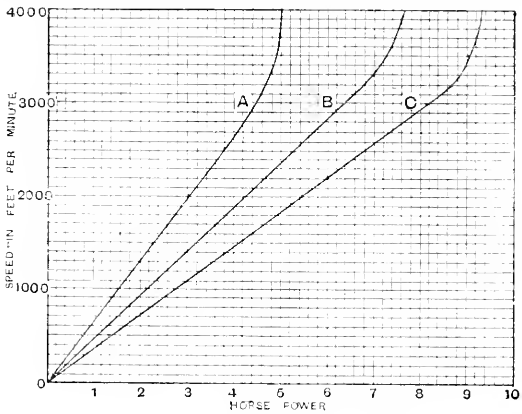
Construction of Double-contact Push.

Separating Lead from Zinc.—The mixture can be raised above a red heat, when the zinc will burn away; or it can be granulated, and then placed in acid to dissolve the zinc. Or stir into the molten mixture a quantity of ground sulphur, which will combine with the zinc and rise to the surface, and form a crust or cake, which can be taken off.

Taking Apart and Cleaning English Lever Watch.—Before attempting to clean a watch, it is advisable to become thoroughly acquainted with its mechanism. First remove the hands and dial, then unscrew the balance cock and take out the balance, unpinning the hairspring if necessary, and notice how far through the stud it comes, so that it may be properly replaced when putting together again. Then let down the mainspring by lowering the click screw under the pillar plate and putting a key on the square of the barrel arbor. Take out the barrel and bar, also the pillar pins, raise the plate gently, and with a pair of tweezers remove the lever; then take off the top plate and remove all wheels, etc. Place all the parts, except the barrel and fusee, in benzine. Take out and brush clean with a soft watch brush and a trace of dry chalk. Brush clean the fusee, take off the barrel cover, and oil the mainspring. With a watch peg sharpened to a fine point, clean out the pivot holes. To put together, place all wheels in position on the pillar plate, but not the lever; put on the top plate, and then introduce the lever between the plates and get it into position; then get the top plate down properly and insert the pillar pins. Put in the barrel and bar, put on the chain by dropping it through the watch in position, and hook the barrel hook in the barrel. With a key on the barrel arbor, wind it all up on the barrel and place the fusee hook in the fusee. Then set up the mainspring half a turn, and wind the chain up on the fusee, being very careful to see that it goes straight. Oil the pivots in the top plate and the balance pivot holes. Put in the balance and repin the hairspring, being careful to get it in beat. To test this, wedge the fourth wheel with tissue paper, and when the balance is at rest the ruby pin should be in the lever notch and the lever should stand midway between the banking pins. See that the hairspring lies flat and beats evenly between the curb pins in the regulator; also see that it does not touch the balance arms or the plate. See that the balance has a little "endshake" in its pivot holes. Oil the bottom pivot holes, and put a little oil on the points of the 'scape-wheel teeth. Do not oil the other wheel teeth or the ruby pin. Use only the best watch oil.

Girard Turbine.—This is a parallel-flow impulse motor, the power being due almost entirely to the velocity of the water. The guide blades, in the vertical form of motor, may be closed by special vertical shutters worked by special gear, and the passages through the wheel are widened towards the outlet of the water. The efficiency of the Girard turbine may be highest on low powers. A suction tube cannot be used, as the wheel must be close to the level of the tail race.

Power Transmitted by Leather Belts.—In the diagram given below, the curve A refers to single belts, best oak tanned, curve B to similar light double belts, and the remaining curve C to heavy double belts. Each curve shows the horse-power that may be transmitted by a belt for each inch in width. Thus a single belt 1 in. wide will transmit about 3 horse-power when running at a speed of 2,000 ft. per minute. Similarly, at that speed, a light double belt will transmit rather more than 4·2 horse-power per inch of width, while a heavy double belt would transmit about 5·4 horse-power. It will be noticed that the lines curve upward at the higher speeds, the decreased power thus shown being accounted for by the centrifugal force set up. To keep the belt central with the face of the pulley, the latter should be slightly rounded, say ⅜ in. or ½ in. per foot.



Power Transmitted by Leather Belts.

Making Sheraton Easy Chair.—The frames of these chairs are made of deal, and the legs of hard wood such as birch. The inside only of the chair is upholstered, the outside being covered with the same material as secured to the frame. The following dimensions are suitable:—Total height of back, 4 ft.; width of seat from front to back, 2 ft.; width of seat, 2 ft.; height of legs from floor to bottom of seat frame, 10 in. without castors; height of arms from seat frame, 1 ft. The back legs should be 1½ in. square; these can be bought ready sawn, with the required sweep of 2 in. at the bottom. The front legs are made from 2 in. square stuff. The seat frame should be 2 in. by 1½ in., raised with a stuffing-rail 2 in. high. The back will have three cross-rails 2 in. by ⅞ in., stump-tenoned into the back legs. Web the insides of the back and arms, and cover with hessian as a foundation for stuffing. Stuff all the inside with hessian before putting on the outside covering, which is usually a cotton imitation tapestry. The edges can be corded or finished with brass or copper nails.

Sizes of Whitworth Nuts and Bolt-heads.—The following table gives the thickness of the bolt-heads and the widths of hexagon nuts in the Whitworth standard. The third, fifth, and seventh columns are to the nearest sixty-fourth of an inch:—

Diameter of Bolt and Thickness of Nut in In.	*Thickness of Head in In.*		*Width of Nut across Flats in In.*		*Width of Nut across Corners in In.*	
$\frac{1}{2}$	·4375	$\frac{7}{16}$	·9191	$\frac{59}{64}$	1·06	$1\frac{1}{16}$
$\frac{9}{16}$	·4921	$\frac{31}{64}$	1·011	$1\frac{1}{64}$	1·16	$1\frac{5}{32}$
$\frac{5}{8}$	·5468	$\frac{35}{64}$	1·101	$1\frac{7}{64}$	1·27	$1\frac{17}{64}$
$\frac{11}{16}$	·6015	$\frac{39}{64}$	1·2011	$1\frac{13}{64}$	1·38	$1\frac{3}{8}$
$\frac{3}{4}$	·6562	$\frac{21}{32}$	1·3012	$1\frac{19}{64}$	1·5	$1\frac{1}{2}$
$\frac{13}{16}$	·7109	$\frac{45}{64}$	1·39	$1\frac{25}{64}$	1·6	$1\frac{39}{64}$
$\frac{7}{8}$	·7656	$\frac{49}{64}$	1·4788	$1\frac{31}{64}$	1·7	$1\frac{45}{64}$
$\frac{15}{16}$	·8203	$\frac{13}{16}$	1·5745	$1\frac{37}{64}$	1·82	$1\frac{53}{64}$
1	·875	$\frac{7}{8}$	1·6701	$1\frac{43}{64}$	1·95	$1\frac{61}{64}$
$1\frac{1}{8}$	·9843	$\frac{63}{64}$	1·8605	$1\frac{55}{64}$	2·15	$2\frac{5}{32}$
$1\frac{1}{4}$	1·0937	$1\frac{3}{32}$	2·0183	$2\frac{1}{64}$	2·36	$2\frac{23}{64}$
$1\frac{3}{8}$	1·2031	$1\frac{13}{64}$	2·2146	$2\frac{7}{32}$	2·55	$2\frac{35}{64}$
$1\frac{1}{2}$	1·3125	$1\frac{5}{16}$	2·4134	$2\frac{13}{32}$	2·78	$2\frac{25}{32}$
$1\frac{5}{8}$	1·421	$1\frac{27}{64}$	2·5763	$2\frac{37}{64}$	2·97	$2\frac{31}{32}$
$1\frac{3}{4}$	1·5312	$1\frac{17}{32}$	2·7578	$2\frac{3}{4}$	3·18	$3\frac{3}{16}$
$1\frac{7}{8}$	1·6406	$1\frac{41}{64}$	3·0183	$3\frac{1}{64}$	3·48	$3\frac{31}{64}$
2	1·75	$1\frac{3}{4}$	3·1492	$3\frac{5}{32}$	3·63	$3\frac{5}{8}$

The odd $\frac{1}{16}$-in. sizes given above are seldom used.

Inexpensive Filter for Oil.—To make a cheap filter for light machine oil, obtain a large ribbed glass funnel about 6 in. diameter; take a clean sheet of thick

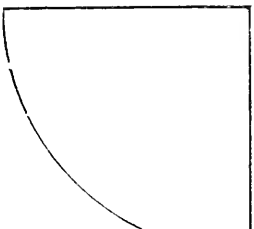


FIG 1

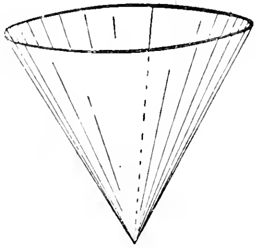


FIG. 2

Inexpensive Oil Filter.

white blotting paper, and cut from it a circle 10 in. diameter, then fold the paper twice to the shape shown in Fig. 1, and open it out like Fig. 2, so that it fits the funnel. Now place the paper in the funnel and the latter into a clean can, and pour the oil into the paper, taking care that it does not flow over. The oil will filter through slowly, and will be perfectly clear and bright. When the paper becomes clogged, it must be replaced by a new piece.

Brazing Bandsaws.—Ordinary bandsaws may be brazed as follows:—Taper the ends of the saw by filing so as to form two wedge-shaped ends for about the length of three teeth. Lap the ends, and place a small quantity of the flux on them; cut off a narrow piece of the brazing metal (about 1 in. by $\frac{1}{4}$ in. will do for an inch saw), place it between the ends of the saw, and cover the joint with flux. The saw, being clamped and held in position in a suitable holder, is now ready for brazing. Heat to a bright red heat a pair of heavy tongs, free from scale between the jaws, and hold them tightly on the saw until the brazing metal melts; then slip off the heavy tongs, and grip the braze with a lighter pair that has been made black hot. When the joint is well set, remove the tongs and file the braze to uniform thickness. The saw is ready for use when the teeth where the joint is made have been sharpened and set. For brazing heavy bandsaws, a small machine may be used, by which the saws are kept in position over the fire by means of a hinged clamp having set-screws on each side of the joint. The brazing is done with two pairs of tongs. Brass spelter and borax as a flux makes very strong joints in bandsaws of ordinary widths. Equal parts of copper and coin-silver, melted well together, rolled out thin and cut in strips, is said to make good brazing metal. One ounce is sufficient to make over thirty joints, in bandsaws 1 in. wide. Two ounces of flux will be sufficient for 1 oz. of brazing metal.

Strength of Springs for Vehicles.—The following list has been furnished by a leading axle maker:—

Mail and Collinge axles suitable for a vehicle bearing the load shown:—

Size	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2 in. diameter.
Weight	5	7	10	12	15	18	22	26	30 cwt.

Drabble and cart arms suitable for a vehicle bearing the load shown:—

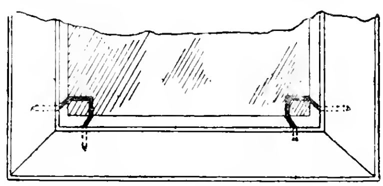
Size	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3 in. diameter.
Weight	10	15	20	25	30	45	55 cwt.

Springs.—A comprehensive list cannot be given, as there are so many variations in size; the quality of steel also has a great influence. The following are a few customary sizes of trap and cart springs, with the weights they are supposed to be suitable for:—

Size of Spring.	*Load Borne by Vehicle.*
44 in. × $1\frac{1}{2}$ in. × 5 in.	6 cwt.
46 in. × $1\frac{3}{4}$ in. × 5 in.	8 cwt.
48 in. × 2 in. × 5 in.	10 cwt.
48 in. × 2 in. × 6 in.	12 cwt.
48 in. × 2 in. × 7 in.	14 cwt.
48 in. × $2\frac{1}{4}$ in. × 7 in.	17 cwt.
48 in. × $2\frac{1}{4}$ in. × 8 in.	20 cwt.

Ordinary merchant quality springs are made of steel of unguaranteed temper, hence the temper is variable, often resulting in weak, unsatisfactory springs. Buyers of springs should require a guarantee that they are made of guaranteed material with a temper, for heavy cart and waggon work, of **not** less than 0·40 per cent. of carbon; for light trap and carriage work not less than 0·45 per cent.

Wire Rests in Wet-plate Photography.—In wet-plate photography, the silver wires on which the plate



Wire Rests in Wet-plate Photography.

rests are fixed in the carrier, as shown in the accompanying illustration. This special device is used because the drippings from the wet plate exercise a destructive influence on the woodwork of the slide, but an ordinary slide may be used if blotting paper is placed along the bottom to absorb the drippings; or the slide may be coated with shellac, asphaltum, or paraffin wax.

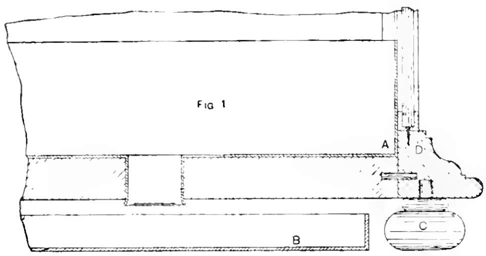
Lead of Slide Valve of Steam Engine.—The lead of a slide valve is the amount by which the steam port is open when the piston is just going to commence its stroke. The supply of steam to the cylinder then commences before the stroke, and the moving piston is brought to rest against a cushion of steam. The amount of lead varies from $\frac{1}{16}$ in. to $\frac{3}{16}$ in., according to the type of engine.

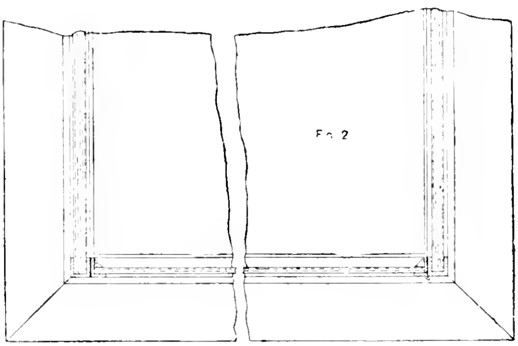
Damp-proof Stiffening Solutions.—For stiffening materials that will be exposed to damp, a solution similar to that used for stiffening hats is suitable. This is composed of 5 parts shellac and 1 part borax, with sufficient water. A useful water-proofing material may be made by dissolving shellac in ammonia. A good stiffening waterproofing material is boiled linseed oil, which stiffens by exposure to air and is very pliable. Another waterproofing substance may be applied by passing the materials through a soap bath and afterwards through alum solution; this produces an alumina soap in the fibres and stiffens the fabrics.

Polishing Ebony Walking-stick.—To polish an ebony walking-stick a jet black, mix Frankfort black or black aniline spirit dye with the polish; the latter may be made by dissolving 6 oz. of garnet shellac in 1 pt. of methylated spirit. Apply with a camel-hair brush. Best results are gained if polishing pads made of wadding enclosed in fine rag are used.

Ink for Rubber Stamps.—To make a good rubber stamp ink, pulverise 180 gr. of aniline violet and dissolve in 2 oz. of boiling distilled water; add one teaspoonful of glycerine and half a teaspoonful of treacle.

Fern Case Construction.—Fig. 1 shows a section through a part of a case for rearing ferns. The bottom is of deal, with a polished mahogany edging or rim which forms a base, the bottom being tongued to it on each side and fixed. The bottom stands ½ in. below the rim, to receive the tray A. The latter is 2½ in. deep, with a hole in the centre to convey superfluous moisture to the zinc safe B underneath, and is covered with a thin layer of broken brick, or other similar material, and with 2 in. of mould, in which the ferns are planted. The safe slides between the feet C, on which the case rests. The zinc tray should be first fitted into the bottom and secured with screws, the heads soldered over, the channel edging D bent to fit the domical glass at each end, and also mitred at the angles to fit the rails on the base, composed of the same section material. Well solder the angles together, then put screws along the inside of the channel into the base, as shown, and run a little fine solder along the edge to fix it to the tray. Then put the glass into position by slightly extending the framework at the ends, and bring the frame tight to it. Take a



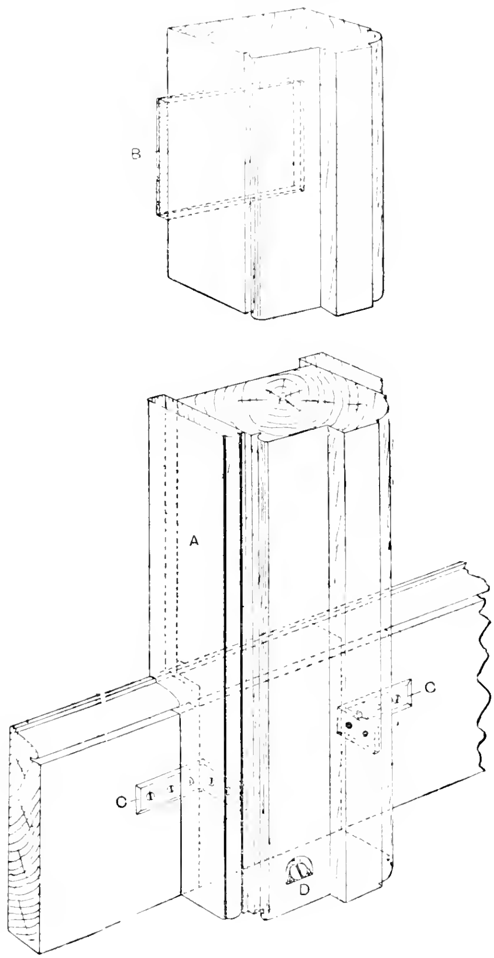


Constructing a Fern Case.

piece of bell tube the same length as the out to out of frame and solder at each end, keeping the joint in the tube at the top. A piece of ornamental cresting, slipped into this joint and soldered to the tube, will give a good finish to the case. Make the doors at each end out of angle pieces to fit the frame as shown, and hinge on the side. The glass in these doors must be left short from the top for the admission of air, otherwise the plants will be stifled.

Steam Consumption in Engines.—The most economical steam consumptions in simple, compound, and triple engines per indicated horse-power hour have been found on trials. A simple Corliss engine has used 17½ lb., and a simple Schmidt engine, with superheated steam, 17¼ lb. Of compound engines, several American, French, and German engines have used more than 12 lb. and less than 14 lb., while a triple-expansion Willans engine may use 12¾ lb., and a similar Sulzer engine less than 12 lb.

Removable Vestibule Screen.—The sketch shows how a frame may be fixed, without injury to the premises, as a tenant's fixture, removable at the expiration of the lease. No plugs are allowed to be put into walls, and where fixing is required it must be done by means of screws—nails are not permissible. Take the exact width between walls, and allow 1¼ in. narrower in the outside width of the frame. The skirting projects, say, ¾ in. on each side: the frame must be scribed over this equally on each side, as shown. Get four brass angle-plates C, chamfered on face for preference; let one side into the edge of the frame in each case, the other screw on to the face of the skirting. This will securely fix the lower part; an additional fixing is obtained by screw D into floor. The upper part must be secured by means of folding wedges B, 4 in. wide, between the frame and plaster. These should be driven tightly home, and should be placed as nearly as possible over the jamb at the top and at the level of the transom at the side. When the frame is firm, drive some fine brads through the edge of the frame into the wedges, to keep them from



Vestibule Screen as Tenant's Fixture.

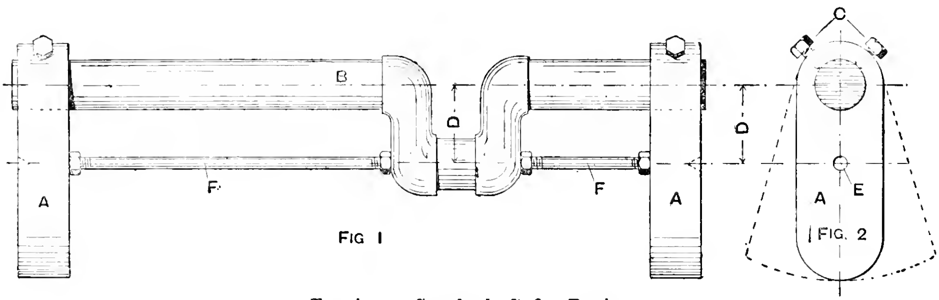
moving if the frame is jarred by the banging of the door at any time. The fillets A shown on the edge may now be fixed; they must be scribed over the skirting and to the plaster, and fixed to the frame with panel pins. These fillets completely hide all fixing with the exception of the end of the brass bracket on the skirting, and this is not unsightly. The job, if carried out properly, will be a good one, and the screen, while equal in stability and appearance to a permanent fixture, can be quickly and easily removed.

Resin used in Spirit Varnish.—Shellac dissolved in spirit forms the basis of most spirit varnishes; the addition of resin is often advised on the score of cheapness. It also assists the varnish to flow level, gives it more body, and imparts a brightness not obtainable by the use of shellac alone. As excess of resin yields a varnish easily scratched, benzoin is added to make it harder, in addition to increasing its brilliancy. Shellac and spirit alone will suit for some purposes as a varnish, but will generally need more shellac in than when for use as French polish to be applied by means of pads.

Renovating Patent Leather Shoes.—To renovate the enamel of patent leather shoes, tree them up tight, and with a sharp knife skive off all the ragged parts of the enamel. Now rub over the whole with very fine sand-paper. This will make the shoes look dull, but they can be revived with leather varnish, patent varnish, ordinary black cream, Nubian, ebonite, or even a thin coat of black polish as used by French polishers.

Putting Spring Seat to Cushion-seat Couch.—To convert a cushion-seat couch into a spring-seat couch, take off the couch back; this will be nailed to the body along the bottom and into the head. If the bottom is boarded, remove the boards, and put a stuffing rail on the front 2in. high; this will leave a rebate for tacking, banding, etc. If a very soft seat is desired, cross-web the bottom with best spring webbing. If spring rails are required, let five in at equal distances apart in the front and back rails. Ten 8-in. spiral springs will be wanted; secure two to each spring rail with wire staples, or, if a webbed bottom, tie fast with strong twine through the web. Cover the bottom over the springs with coarse canvas, tack on the front side securely, and pull down the other till the springs are compressed about a quarter their length; then tack the other side. Put your arm under the ends, and place the springs in an upright position, then stitch fast to the cover with needle and twine. Put on a layer of flocks about 2in. thick, cover the top with another piece of canvas, and tack fast all round; stitch up the front edge to a fine point with four rows of stitches. The couch will now be ready for outside covering.

Turning a Crank-shaft.—The adjoining sketches show one method of turning the crank-pin of a small crank-shaft of an engine, Fig. 1 being a front elevation and Fig. 2 a side view. Iron slabs, lettered A, are fastened, one at each turned end of the shaft B, by set screws C. The slab is centred at E, so that D in Figs. 1 and 2 represents the throw of the crank. Sometimes the hole in the slab is larger than the turned end of the shaft; the hole is then packed so that the distance D between the centres can be adjusted. To stiffen the system, long bolts at F are introduced, being jambed tight by nuts at the ends. The slabs are often to the shapes shown by the dotted lines in Fig. 2. The centres of the slabs and of the crank-pin must be in line, the positions being set by the aid of vee-blocks, plumb-bob, and scribing block.



Turning a Crank-shaft for Engine.

Proportions of Square Nuts and Bolts.—The following are the usual proportions of square nuts and bolt-heads:—The width across the flats of black nuts may be one and a half times the diameter of the bolt, plus from ·18 in. to ·44 in.; or of bright nuts, one and a half times the diameter, plus from ·06 in. to ·18 in. Across the angles, rough nuts may measure 2·12 times the diameter, plus from ·25 in. to ·6 in.; and bright nuts, 2·12 times the diameter, plus from ·08 in. to ·25 in. The height of the bolt-head may be from two-thirds of the diameter of the bolt to equal to this diameter.

Dull Black Finish for Furniture.—To make a black stain that will give a dull finish, as seen on Chippendale furniture, it is usual first to stain the wood with extract of logwood and copperas, followed by solutions of acetate or sulphate of iron. This, in turn, is French-polished, an intense black being obtained by adding black aniline spirit dye to the polish. When perfectly hard, this is dulled by well brushing with finest-grade emery or pumice powder. Staining alone is rarely sufficient for any but the very cheapest class of work. The following is the French method of obtaining a dull finish on high-class goods: The articles are first coated with camphor water, and almost immediately afterwards with a coat of sulphate of iron and nutgalls. When quite dry, the surface is rubbed with a very hard brush of couch-grass, and then with the lightest and finest-quality charcoal, the flat portions with stick or cake charcoal, the carved or incised portions with powder, using linseed and turpentine to keep the surface cool and moist. This process yields best results when employed on woods of a hard, close grain.

How to Make Collodion.—Take 1 oz. of pyroxylin or collodion cotton, 36 oz. of ether, and 12 oz. of alcohol of 90 per cent. strength; place in a dry, stoppered bottle, and shake from time to time till dissolved. The best liquid for diluting the collodion is a mixture of ether and alcohol in the above proportions.

Drying a Mop.—As a means of twisting a mop for the purposes of drying, other than by the ordinary method of using one hand and a wrist, a hole is sometimes bored through the handle about 15 in. from the upper end, and through this is rove a short line, say 30 in., a knot tied close to the hole on either side keeping the line in place. By starting the mop twisting in a vertical position and pulling both ends of the line and releasing them together, the mop is rotated quickly in alternate directions.

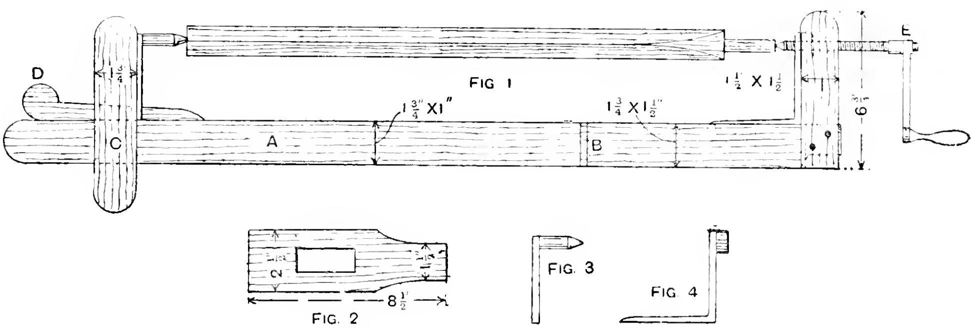
Red Filling for Letters on Engraved Door-plate.—When filling an engraved door-plate with wax, the utmost cleanliness must be observed, as any foreign matter rises to the surface, and the wax should be rubbed down till a clean and brilliant colour is established. The best vermilion wax should be obtained, and it should then be powdered. To do this, break the wax into convenient pieces, and place between two clean pieces of brass or iron plate; wrap the whole in several thicknesses of brown paper, tie with twine, and hammer the package well. This will make the wax quite small enough. Another plan of filling the lines is to heat the plate, and rub in the wax from the slab or stick; another is to grind up the powdered wax with gold size, set in with a palette knife, and put aside to harden. Clean off with alcohol. Or dissolve wax in pure alcohol to a creamy mixture, so that it will pour freely and fill the letters; leave to set hard, then clean up with spirit.

Hardness of Water.—The hardness of water depends to a very large extent upon the nature of the rock through which it percolates, and the extent to which it penetrates. Deep well water obtained from a shaft sunk to a great depth into water-bearing strata is usually more or less hard. Water issuing from springs may be either soft or hard; from granite and the older rocks the water is soft, because it penetrates but little; but in the newer formations, especially magnesian limestone, oolite, lias, chalk, etc., the spring waters are very hard. Water from the surface flowing over pure clay or gravel will be, as a rule, soft, because there is little soluble matter contained therein; but from a shell gravel the water will be hard. Water collected in shallow wells is often very hard, the water percolating readily through the soil and subsoil, and dissolving out the salts contained therein. The salts not precipitated by boiling are removed every time the kettle is emptied; the scale will contain principally the carbonates. In a boiler the case is different, as the concentration of the water by evaporation causes the precipitation of both carbonates and sulphates; but an analysis of the water is better, because there may be present chlorides of calcium and magnesium, which also render the water hard, and may cause trouble in other ways. These salts are extremely soluble in water, and would not precipitate however long the water was boiled. The deposit inside a kettle would be white if only lime and magnesia were present; but if iron were also present, the deposit would be yellowish or cream-coloured.

Soldering a Silver Watch Case. — Ordinary easy running silver solder, which melts at a lower heat than silver, will do. But to make sure, shred the solder into very thin strips, and apply plenty of borax to them as well as to the joint to be united. Use the blowpipe gently at first so as to bake the borax, then heat the case all over almost to the melting point of solder, and direct the flame to the part to be soldered until the solder runs and glistens. Cease blowing instantly, and plunge the case into a solution of sulphuric acid 1 part and water 10 parts, to whiten it; then wash in hot water and dry in sawdust. Be careful to remove all steel springs before soldering a case.

Size of Corliss Valves for Steam Engines.—The diameter of Corliss valves used for the admission of steam to engine cylinders when the diameters of the cylinders are known may equal one-eighth the diameter of the steam cylinder plus 2 in., while the diameter of similar exhaust valves may equal one-sixth the diameter of the cylinder plus 2 in. Thus, for a cylinder 24 in. diameter, the steam valve should be $\frac{24}{8} + 2 = 5$ in. diameter, and the exhaust valve $\frac{24}{6} + 2 = 6$ in. diameter.

Dressing Up Spokes of Carriage Wheels. — An easily made apparatus that will hold the spokes of wheels whilst dressing them up is illustrated by Fig. 1, which is a side view showing a spoke in position. The bottom rail A is $1\frac{3}{4}$ in. deep by $1\frac{1}{2}$ in. thick, shouldered in at B to 1 in. thick. On this part the block C works along by the mortise shown in Fig. 2, being kept in position by the wedge at the back D (Fig. 1). To this block is fixed an iron plate (see Fig. 3), the lower part being $1\frac{1}{2}$ in. wide by $\frac{1}{4}$ in. thick, the projecting centre-point being [illegible] in. round, welded into it. A pillar $1\frac{1}{2}$ in. square is mortised on the front end, being firmly fixed by a corner plate, as Fig. 4. This is made with a boss at the top to the full width of plate, $1\frac{1}{2}$ in., through which the $\frac{5}{8}$-in. screw E is fitted. This has a handle fitted at the end, and when in use the frame is held in the vice, or may be cramped to the bench, and the block is slid along to about the length of the spoke. The latter is placed between the two centre-points, a turn or two of the screw holding the spoke firm, whilst it can also be turned round in any position for working.



Apparatus for Holding Spokes of Wheels.

Cleaning and Relacquering Brass.—To clean and relacquer brass fittings, take all the parts to pieces and place them in a boiling solution of carbonate of soda or potash, 1 lb. to a gallon of water. To remove the old lacquer, swill in clean water. Then dip in commercial aquafortis quickly several times till of a golden colour, swill each time in clean water, and add a pinch of cream of tartar to the last swilling. Dry out in hot sawdust. Burnish the bright parts with a steel burnisher, using a little oxgall to lubricate. Dry out in sawdust as before. Heat on a hot plate, and lacquer with a camel-hair brush.

Tinning Sheet Copper.—If to be tinned on one side only, first smear with salt and water the opposite side; then, with a pad of tow, wash the other side with killed spirits (chloride of zinc), and also sprinkle a little powdered sal-ammoniac over the surface. Place the sheet over the fire, and when hot enough, rub the end of a strip of tin on it until a small portion of the tin melts: then, with a pad of tow or wadding, on which some powdered sal-ammoniac has been sprinkled, rub the molten tin over the hot surface, and continue this operation until the whole surface is covered. If the copper is to be tinned on both sides, an iron bath of semicircular section, built up over a firegrate, should be used. Having melted a sufficient quantity of tin in the bath, pass the copper sheet through it, and as it is withdrawn, quickly wipe the superfluous tin from each side with a pad of tow. The surface of the copper should be first prepared as described above.

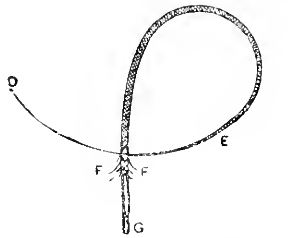
Green Stain for Wood.—A clear dark green stain may be made by mixing aniline dyes as sold at most druggists' with plenty of hot vinegar. Green and blue yield a useful tone. Or apply hot 2 oz. of verdigris, $\frac{1}{2}$ oz. of China blue, and 1 pt. of vinegar; several coats will be required. These water stains have a tendency to raise the grain. The subsequent rubbing down with glasspaper will give the white flecks often seen on frames. If this is objected to, colour must be used in the polish or varnish. Another simple plan is to use emerald and bronze green mixed in hot beer.

Making Photographic Prints by Gas and Dull Light.—Any gelatino-chloride paper may be slightly printed and afterwards developed. The great drawback to the process is the liability of obtaining degraded high lights with a consequent flattening and fogging of the image; because if the faint image from a brief exposure under a negative can be developed into a dark print, any chance exposure of the paper to daylight will show by fog and degradation. If the paper has been properly protected from extraneous light and is otherwise suitable, development has a tendency to intensify the contrasts, therefore a little fog is sometimes an advantage unless allowance has been made in the negative. Eastmans', Paget, and Otto gelatino-chloride paper can be recommended for this process. Print a faint image in diffused light—that is, expose for about five minutes to daylight or one hour at 6 in. from an incandescent gaslight. Make up the following solutions:—No. 1. Hydroquinone 25 gr., metol 10 gr., sulphite of soda 25 gr., potassium bromide 50 gr., ammonium bromide 100 gr., water 8 oz. No. 2. Sodium hydrate 15 gr., water 2 oz. No. 3. Tannic acid 8 gr., water 1 oz. Take thirty-two parts of No. 1, eight parts of No. 2, and one part of No. 3. Immerse the print without washing. It rapidly bleaches to a light yellow, then slowly increases in density. When nearly dark enough, remove the print and place it in a 1 in 60 solution of acetic acid, and thoroughly wash for ten minutes. Great care must be taken to wash out all the acid, or uneven tones will result. The print may then be toned in the ordinary sulpho-cyanide bath and fixed as usual. Avoid handling the paper or stains will result. Another method by which prints of a fairly satisfactory colour may be obtained without toning consists of pouring over the dry print a solution of pyro 1 gr., bichromate of potash solution (1 gr. in 2 oz.) 10 minims, water 1 oz.; a print of a sepia tone results. But it is difficult to avoid degraded high lights: it is, in fact, practically impossible if a larger proportion of bichromate solution than that given above is used. An acid fixing bath has been recommended.

Cleaning Buff Leather Gaiters.—To clean gaiters made of sun tanned sheepskin, with the flesh side outside, wash them thoroughly and scrub out all the dirt. When quite dry, scrape them all over very lightly, paying special attention to the parts that were dirtiest, with a dull knife, a buff knife, or the edge of a blunt shoemaker's knife; if the knife is too sharp the leather will be worn away. When the gaiters are rough all over, apply some Propert's brown ball, or a mixture of brown ochre and chalk mixed to the shade required, and rub in well with fine sandpaper, then with a piece of old cloth. If the gaiters are then brushed out lightly with a soft brush, they will have the appearance of new goods.

Secret or Invisible Inks.—The usual invisible or sympathetic inks are made from cobalt nitrate or chloride, which in the hydrated condition (that is, containing water) are a pale pink, but become deep green by loss of water on heating. Writing upon paper with these inks is invisible at the ordinary temperature, but by warming the paper the marks appear very distinct, but fade away again after a short time. In hot climates the writing would not be invisible. Invisible writing may be done with a solution of tannic acid, and developed at any time by soaking in a dilute solution of ferric chloride. A true ink is then formed. Another method is to write with a solution of boiled starch, and develop the writing by damping the paper and holding it for a few minutes over a bottle containing iodine; the blue iodide of starch is then formed, and the writing becomes quite distinct for a time. It fades away again as the paper dries, but may be developed in the same manner several times. Another process is to write with a solution of lead acetate, and develop by moistening the paper and holding it over a bottle containing sulphuretted hydrogen; the writing then becomes permanently black, sulphide of lead being formed.

How to Put a Bristle on a Waxed Thread.—To put a bristle on a waxed thread, as used in shoemaking, D shows the bristle split, and the end of the taper of the thread in the crutch of it at E. Hold this point between the thumb and finger of the left hand, so that it does not pull out at the bottom F while the two are being twisted together with the thumb and finger of the right hand. When twisted, still hold them firmly at E, and put the bottom



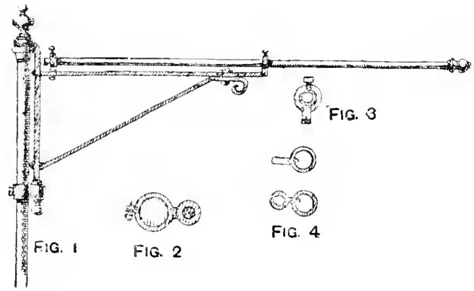
How to Put a Bristle on a Waxed Thread.

F between the little finger and the next finger. With the right hand twist the other portion of the bristle—that is, the top F. Then put the two F's together, hold them with the right hand and let go with the left, and D and E will twist of their own accord. Then fasten the ends at F so that they cannot untwist, as in the adjoining sketch. Take G as the thread or waxed end, and through this make a hole between F F and E, but very near to F F; then take D and pass it through this hole. By pulling D, E will also pass through the hole—in fact, all the bristle except the two ends F F; that portion of the thread will also pass through that has been twisted in with the bristle.

Sticking Artists' Canvas to Millboard.—Having rubbed the back of the canvas with coarse glass-paper, coat the material with some strong glue, rub down thoroughly, and press until dry. Failure often occurs through not properly removing the air from between the picture and the millboard. The correct method is to place a square of thick paper over the face of the painting and then expel the air by rubbing, with closed fist, over the whole surface, commencing from the middle and rubbing towards the outside edges. If air gathers under the middle, and it cannot be forced out round the edges on account of the glue having set, prick the blister with a fine needle, and, having let the air escape, rub down well and put a weight on the spot for an hour or two.

Photographic Lens for Portraits and Enlarging.—Any lens may be used for enlarging quarter-plate pictures to about 12 in. by 10 in. Theoretically, the best lens to use for the purpose is the one that has been employed to take the picture. Practically, the best lens is a portrait or rectilinear lens having a flat field and a large aperture. The focus should not be long, or the camera will require great extension. If a 6-in. focus portrait lens is used, the camera must be extended 24 in. and the lens be placed 8 in. from the small negative. It is only necessary that the lens should sharply cover the small negative. Only quarter-plate portraits could be taken with a 6-in. lens. In some cases it may be best to fit the enlarging camera with a 6-in. rectilinear lens by a good maker (such as Ross, Dallmeyer, or Taylor), working at $f/6$. This could be used as it stood for ordinary work and enlarging; whilst an occasional half-plate portrait could also be taken by using the front combination only, provided the extension of the camera is sufficient. If not, a conical front could be made to accommodate it. Every lens is supplied with a flange, which only needs screwing to the opening in the camera front. As daylight enlargements are best, it is unnecessary to have a camera for enlarging. Place the small negative in a carrier in the dark slide with both shutters drawn out, insert the slide in the camera, and place it close against the window frame, with the lens, covered with a cap of ruby glass, pointing into the room. The whole of the window, except a small opening to admit light to the slide, must be blocked out and the room rendered thoroughly dark. Outside the window must be a white reflector, at least four times the size of the negative, fixed at an angle of 45 with the negative, and receiving light from the sky. On placing a sheet of white paper on an upright easel and moving gradually from the lens, a position will be found (viz. 24 in.) where a sharp enlarged image of the small negative is shown on the paper. It is merely necessary then to pin a sheet of bromide paper on the easel and expose. Daylight exposures are constantly varying, and call for some experience, but better gradation is obtained.

Fitting Swing Curtain Rails to Iron Bedstead.—To fasten rails on the two posts of a half tester iron bedstead to carry curtains so that they will swing, Fig. 1 shows the arrangement as fixed on the pillar of bedstead. An iron bracket of wrought flat iron ¾ in. by ¼ in. should be made as shown in Fig. 1, the upper



Fitting Swing Curtain Rails to Iron Bedstead.

part swelled out and drilled so as to fit over the top of pillar on the screw. The brass knob screwed down on it, with a washer between, will keep it in place. Fig. 2 shows the bottom fixing. This is a solid forging drilled through the centre to take the pin of the bracket, and with a clip for the pole fastened to it with a tightening screw. The bracket (Fig. 1) is turned up at the end, swelled out and drilled for a brass tubing to pass through; a small eye similarly made is fixed at the back end of the bracket (see Fig. 3). The brass rod should have eyes fixed into it about 4 in. apart, as shown in Fig. 4. To these eyes the curtains hang from brass hooks. The brass knob at the under side of the solid bracket rest will keep the bracket tight in its position.

Distance of Stop from Lens in Camera.—There is no arbitrary rule for finding the distance of the stop from the lens. It is best discovered by experiment; the point chosen is where the maximum of sharpness is given with a minimum of distortion. If distortion is of little consequence, the stop may be brought forward until its circle of illumination just covers the plate and no more. The experiment may be made in the following manner:—Mount the lens square in a tube and then choose another tube, 2 in. long, sliding into the first easily. (The second or inner tube may be made by rolling and pasting paper round a rod built up to the right size with paper.) At the end of the inner tube, which must be cut straight and true, fix a black card having cut in it an opening about one-third the diameter of the lens or about one-sixteenth the focus. This hole represents the stop, and by sliding one tube within the other the distance between the stop and the lens may be adjusted. Place the camera parallel with a number of straight, clear lines drawn on paper about 6 in. apart and focus them without the inner tube till they are about 1 in. apart. None of the lines will be really sharp. Insert the inner tube and push the stop close against the lens and the definition in the centre will at once be improved, but the definition at the margins will be as bad as ever. Now slowly withdraw the stop and the definition will be seen to spread towards the margins of the screen. As this is done, however, another evil is introduced; the lines at the margins of the paper are bent inwards at the ends and outwards in the centre. This bending of the lines is known as distortion, and is the result of using a stop.

Staining Wood in Imitation of Mahogany.—If the article is unpolished, it may be stained with one pennyworth of burnt sienna ground in water. Mix with stale beer, and brush well over, wiping off the surplus with rag; two coats may be given. When quite dry, rub smooth and coat with several applications of spirit varnish. The colour may be enriched by the addition of a pennyworth of Bismarck brown to 1 pt. of varnish applied with a camel-hair brush.

How to Make a Cheap Writing Table.—The accompanying illustrations show how to make a small writing table. The timber used may be common deal, in boards 4½ in. wide and ⅞ in. thick; 56 ft. will be sufficient. Saw seven lengths for the back, 3 ft. 6 in. long, and twelve lengths, six for each side, 2 ft. long. The sides and back may now be either nailed or dovetailed together. Dovetailing is best, but it is the more difficult to do. If nailing is resorted to, four uprights should be obtained, 1½ in. by 1½ in. by 2 ft. 1½ in., and one placed in each corner, so that the boards may be nailed to them. When this has been done, fix the board in front (D, Fig. 1), and then nail ledges, level with the bottom of this board, each side and along the back to support the bottom of the desk. The bottom may then be put on, but the wood for this need be only ⅜ in. thick (an old egg case will do). Then the sloping pieces (Fig. 2) should be cut; these should be cut out of one piece. When these have been fixed on to the back and sides, the lid should be got ready; it should measure 2 ft. 7½ in. by 1 ft. 7½ in., so that it will leave ⅞ in. projection each side and ½ in. in front. Put the catch of the lock on the lid, and fasten the lid with hinges to the 5-in. board, then secure it to the sides and back. The supports for the shelf C (Fig. 1) should be cut as shown. When the shelf has been cut to the required length, 2 ft. 6¼ in., it should be let into the shaped sides ½ in., and nailed. This may now be fixed on to the top of the desk as shown in Fig. 1, and as there is ⅞-in. projection at each end, the nails or screws should be driven upward. The top part of the shelf can be used for books, etc., and underneath pigeon-holes can be made, if desirable. Now fit in the lock, cut out the keyhole, fill up all joints, etc., with putty, and rub all over the table with glasspaper, and it is ready for staining.

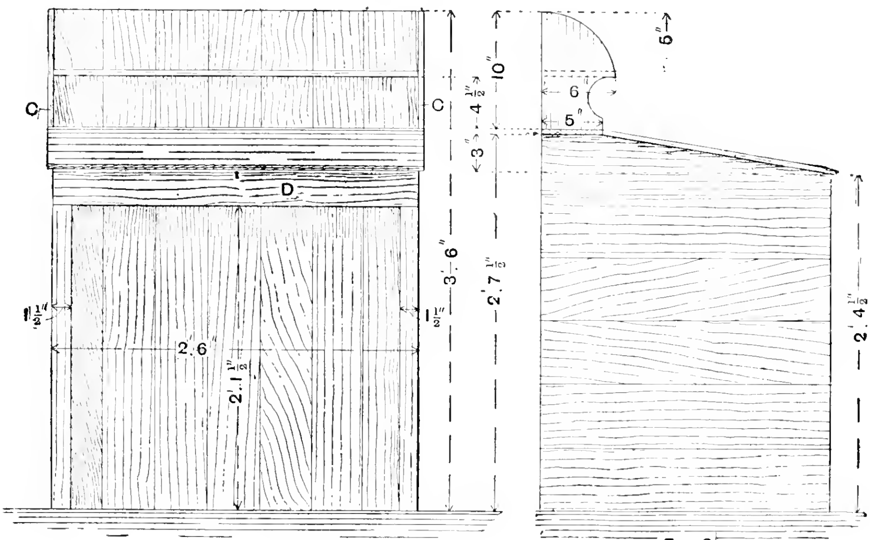


FIG. 1 FIG. 2

How to Make a Cheap Writing Table.

Self-polishing Blacking.—To make blacking that requires no polishing, take 4 oz. of treacle, ½ oz. of lamp-black, a tablespoonful of yeast, two eggs, a teaspoonful of olive oil, and a teaspoonful of oil of turpentine; mix well, and apply with a sponge.

Polishing Stalactites.—The principal thing in polishing stalactites and small stones after they are cut is to grade the hardness of the polishing material with the stone to be polished. For cutting a surface level, use various grades of emery on lead laps, with a separate lap for each grade of emery. See that all scratches are removed. For the polishing, on hard wood that will not warp glue a piece of buff leather. On this place a little putty powder, which, like the emery, must be used wet. The following has been given as best for soft stones:—Take, say, ½ lb. of putty powder, put it in a jar, cover it with nitric acid, and place it in the open air, as the fumes are noxious; let it stand for a day, then pour off acid and water repeatedly until the water ceases to be acid. Polish with the residue.

Curing Rabbit Skins.—To cure rabbit skins, mix bran and three or four times (by measure) as much boiling water, and add 1 lb. of alum and ½ lb. of salt to every gallon of water. Stir to dissolve the salts, and then cover with a cloth until about new milk warm. Place the skins in this, and leave for about twenty-four hours; then dry them in the shade, stretching and rubbing them well. Stir up the mixture, and replace the skins for twenty-four hours; then dry again, repeating the stretching and rubbing. For large skins, the rubbing is supplemented by scraping the flesh side with a knife to loosen the fibres. Many now make a mixture of oatmeal and hot water, and before this is quite cold immerse the skins in it for twenty-four hours, and then dry and hand rub as before. If the rubbing has been thorough, the skins should be as soft as chamois leather.

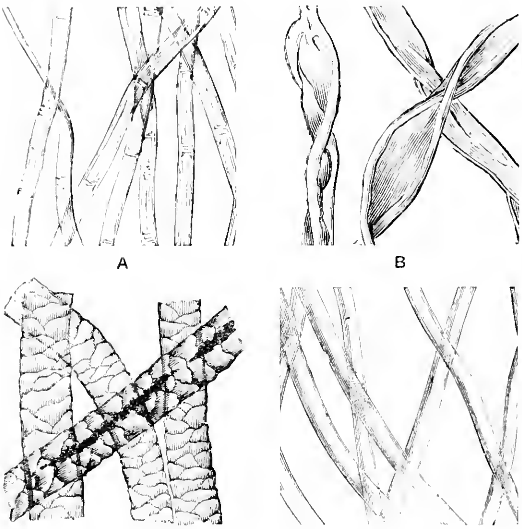
Rule for Velocity of Steam.—It has been found that the discharge of steam through an opening into a pressure less than three-fifths the initial is about 900 ft. per second. The following rule has been given to determine the velocity in feet per second when steam flows into a vacuum:—To the Fahrenheit temperature of the steam add 460, and multiply the square root of the sum by 60. The area of pipes for steam engines should be arranged so that the velocity of the steam does not exceed 130 ft. per second; a lower velocity is better.

Stereoscopic Photography.—For most subjects, except instantaneous stereoscopic work, an ordinary quarter-plate camera, with one lens only, may be used if provision is made for shifting the camera or the lens from side to side for a distance of from 2½ in. to 2¾ in.; or if the object itself can be moved the same relative distance the camera may remain stationary; or achromatic lenses, paired for stereoscopic work, could be fitted to a half-plate camera. As to plates, in a half-plate camera double quarter-plates (6½ in. by 4¼ in.) are often preferred. There should be a partition between the lenses, and this may easily be made in a square-bellows camera by pleating some flexible black material over two slips of elastic and fastening it to hooks in the camera front and in the back frame.

Distinguishing Worsted from Cotton Cloth.—The best way to distinguish a cotton cloth from a worsted cloth is to unravel the edge, and if of cotton it will have a wiry appearance; worsted is soft and woolly. But if there is any doubt, hold the threads over a lighted lamp beyond the flame; if of worsted, they will shrivel up and burn into a black cinder; if of cotton, they will remain stiff till they get red hot, when they will burn into a white ash.

Dead Black for Interior of Camera. To make a dull black stain for the interior of a camera, mix powdered lampblack and French polish, using of the latter only just enough to make the black adhere. Too much will produce a polished appearance. Another recipe is: Aniline black, 100 gr.; gum shellac, 200 gr.; methylated spirit, 5 oz. Dissolve thoroughly, and apply with a soft brush quickly. Negative varnish and powdered lampblack may also be used.

Difference between Linen, Cotton, Wool and Silk.—To distinguish the difference between linen, cotton, wool, and silk, examine the fibres under the microscope with a moderately low power. It will be found that the linen or flax fibres consist of transparent tubes, sometimes marked with lines and having very small central canals (see A in the illustration). The cotton fibres consist of straight or twisted flattened tubes with very large central canals and quite transparent (see B). The wool fibres are very variable, but consist of a number of plates or scales built up to form a tube, and the inner tube is usually more or less coloured in the natural wool (see C). The silk fibre is usually very small and perfectly smooth (see D). The action of chemical agents upon the fibres depends upon their composition. Flax and cotton are nearly pure cellulose. By the action of moderately strong acids, the fibre is somewhat attacked, and the



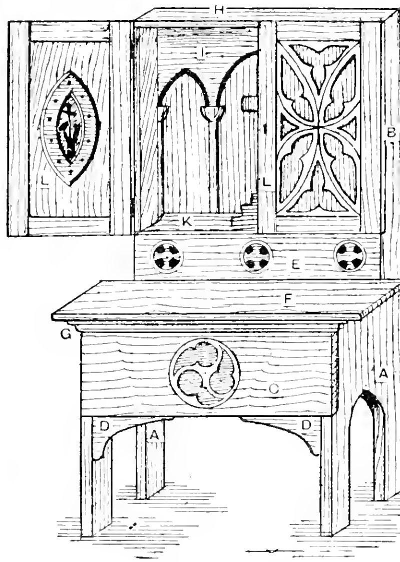
Magnified Fibres of Linen, Cotton, Wool, and Silk.

result is a parchment-like product; by long-continued action of strong sulphuric acid, cellulose is converted into dextrine, and by dilution with water and boiling it finally becomes glucose (a kind of sugar). Strong nitric acid converts cotton into nitro-cellulose or gun-cotton. Weak alkalies do not affect cotton or flax; strong alkalies toughen the fibre and shrink it, forming mercerised cotton. Wool fibre has a composition similar to skin, horns, and feathers, and is composed of nitrogenous material called keratin, but contains sulphur also. Dilute acids do not affect wool; strong nitric acid and other acids destroy it, the former first rendering it yellow. Alkalies render wool very tender; strong alkalies used hot dissolve wool completely. Silk contains fibroin, gelatine, wax, albumin, etc. Concentrated acids destroy silk, but dilute acids do not affect it much; simply boiling with water removes the gelatine or sericin, which amounts to about 20 per cent. Weak alkalies impair the silk, and strong alkalies easily dissolve the silk entirely.

Drilling Holes in Glass.—To cut a 1-in. hole in a glass plate a copper tube may be used for drilling. Use a tube about ¾ in. diameter with the end spread to 1 in. diameter. Emery powder should be fed inside the tube to form the cutting material and turpentine used to dissipate the heat. The tube must, of course, be pressed on the glass and rotated.

Flattening Buckled Copper.—To flatten copper that is buckled, hammer the surface with a light planishing hammer on a bright tinman's anvil, commencing at the end and going backwards and forwards across the metal with a series of regular blows, until the entire surface has been covered. Any hollow places along the centre of the strip must be drawn down flat by hammering from the edge of the hollow out to the edge of the strip. Should the strip be wavy or loose along the edge, hammer along just inside the edge and work back towards the centre of the strip until the edge is drawn flat.

Private Altar.—For a small private altar which can be closed when not in use the accompanying figure is suggested. The dimensions are as follows: Length, 24 in.; projection from wall, 20 in.; height of altar, 21 in.; and height of reredos above altar, 18 in. The ends A A are of inch board shaped as shown, the back length in each running up to the top of the reredos, as at B. The front is chiefly formed of a stout piece of 9-in. board C, pierced with a medallion of tracery, which is let into the edges of the end pieces. The spandrels below (D D) are separate pieces fixed to this board. A similar board, but plain, is at the back. The front of the super-altar E is ornamented with sunken medallions. This rises about 4 in. above the altar top F, and might have a projection of 5 in. or 6 in. The altar top is made to overhang at front and ends, and a bold moulding G, mitred at the corners, runs beneath it. The reredos has a piece H running along its top of the same width as its ends. Half-inch boarding will do



Private Altar

for its back, and in order to show up the cross, etc., the back might be lined with velvet, the Gothic arcade I being sawn out of thin board, worked up, and fixed upon the lining. A piece of thin board K, covered with similar velvet, should be fixed along the top of the super-altar above its true top, and will serve for the doors to fold against. The doors L L are hinged to the stout end pieces. On their inner sides the panel of each might be gilded in diaper and painted with the gold as a background; or it might be lined with velvet, on which a sacred monogram or emblem in brass could be fixed. The outer side of one of the doors is shown with its panel filled with tracery sawn from thin board, worked up with chisel and gouge, and fixed upon the wood.

Liquid used for Gold Paint.—In the manufacture of gold paint pale copal varnish, thinned with turpentine, is often used. Some gold paints are made with a white spirit varnish; others are mixed with a medium prepared by dissolving collodion cotton in amyl acetate and diluting with petroleum ether. When the bronze powder has to be mixed with the medium, pale copal varnish, thinned with turpentine, is very often employed.

Cements for Oil Lubricators.—There are two suitable cements that will withstand oil and heat. The first is made by separating the white from the yolk of an egg, and mixing the former to a stiff paste with powdered quicklime. The second cement is made by boiling together 5 parts of water, 1 part of caustic soda, and 3 parts of resin. When the resin is dissolved, the liquid is mixed with half its weight of plaster-of-Paris, and at once used, as both cements set hard in a very short time.

Making Cart Grease.—The materials employed are resin oils, resin, heavy petroleum, animal grease, soda, lime, etc. The following may be taken as examples:—(*a*) Petroleum residue 40 gal., resin 60 lb., animal grease 59 lb., caustic soda lye $2\frac{1}{4}$ gal., salt 5 lb., dissolved in a little water. The oils are heated together, and the soda lye and salt gradually stirred in, when partial saponification takes place. (*b*) Resin oil 100 lb., and slaked lime 90 lb.; heat together, and stir thoroughly until a homogeneous mass is formed. (*c*) Heat together 1 lb. of palm oil, 1 lb. of palm oil soap, 55 lb. of resin oil, and then gradually add, while stirring, 10 lb. or 20 lb. of strong soda lye, until a uniform paste is formed. These greases are sometimes mixed with blacklead, or rendered thicker and more viscous by additions of inert weighting materials, such as barytes, china clay, gypsum, etc.

Oven for Case-hardening Cycle Parts.—The construction of an oven for case-hardening cycle parts is shown in sketch. Fig. 1 is a longitudinal elevation showing the air holes at the sides. These are simply spaces for half bricks. Fig. 2 is a longitudinal section showing the brickwork construction, the outside being best red ordinary bricks with an inside lining of best quality firebricks. The hardening box is shown in position in the centre of the fire. Fig. 3 is a cross-section, not, however, taken through the air-holes. The size of the oven must be regulated by the size of the articles to be hardened. A good size for ordinary work would be 3 ft. or 3 ft. 6 in. long by 2 ft. wide.

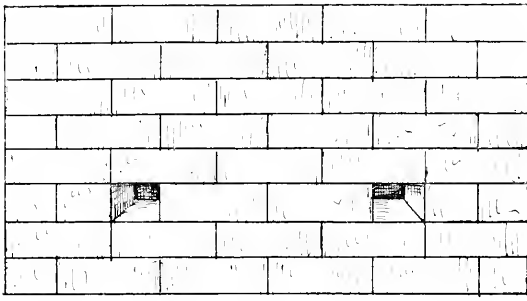


FIG. 1

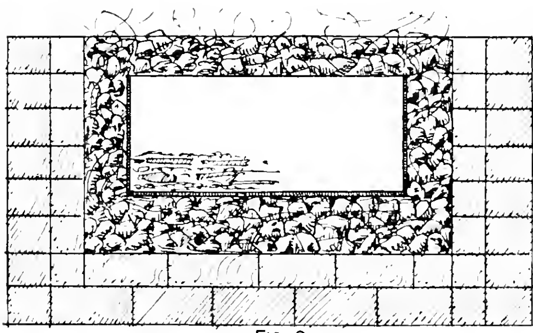


FIG 2

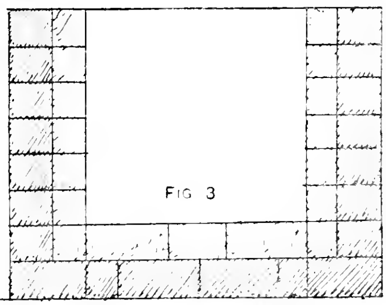


FIG 3

Oven for Case-hardening Cycle Parts.

Easily-made Lantern Slides.—To make these, some glass cut to the size of the lantern slide, and some prints about the size of the slide, must be selected. A series illustrating travels or manufacture will be found a very suitable subject. The print is well covered with starch paste on the picture side, and laid on one of the pieces of glass, the surplus paste being worked from the centre to the edge with a piece of cloth wrapped over a cork. Great care must be taken that the paper adheres to the glass, no air bubbles being allowed to remain between the glass and the paper. When dry, with a rubber made of a piece of cork covered with the finest glasspaper, work the back of the picture off until there is only a thin film of paper left, care being taken that the paper is not rubbed through to the glass. To get an even thickness, hold the slide up to the light, when the thickest parts will show dark; these spots must be worked carefully off until the whole surface is of an even transparency. If desired, the picture may now be tinted with transparent colours. The slide is now brushed over with a varnish made of equal parts of Canada balsam and spirit of turpentine, and, when dry, mounted in the usual way. With care during the process these slides will almost equal photographic ones both in transparency and sharpness. The half-tone prints taken from photographs make excellent slides. Another simple method when hymns or diagrams for educational purposes are to be thrown on the sheet, is as follows: First get some ground glass cut to the required size. Draw the diagram, or write the hymn in a circle 3 in. in diameter on paper. Lay the glass on the drawing, or writing, ground side upwards, trace over the lines with a sharp-pointed F pencil, or with Indian ink, using a small mapping pen. Float with the Canada balsam varnish by holding the glass at one corner, pour the varnish on the centre, spread it by rocking the glass backwards and forwards until the whole of the glass is covered, and drain off the surplus back into the bottle at one corner. When dry the slide is ready for mounting.

White Acid for Glass Embossing.—Hydrofluoric acid, diluted with water, is principally used in glass etching, but there are several fluorides used for the purpose. Fluoride of ammonia is formed by adding ammonia to hydrofluoric acid until it is nearly saturated; if a slight excess of ammonia is added so that the mixture smells of it, and then a little more acid be mixed with this, the fluoride will be suitable for glass etching. The fluoride of ammonia is placed on the glass and allowed to dry, when the etching effect then becomes apparent. Another etching fluid is made by dissolving 25 parts of fluoride of potassium, 25 parts of hydrochloric acid, and 14 parts of sulphate of potash in 100 parts of water. Another solution is made by dissolving 10 parts of carbonate of soda and 10 parts of carbonate of potash in 40 parts of warm water, and then adding 20 parts of concentrated hydrofluoric acid and 10 parts of sulphate of potash previously dissolved in 10 parts of water.

Weight of Cast-iron Balls.—To calculate the weights, first determine the contents of the balls in cubic inches, and then multiply by ·26. To find the contents of a sphere or ball in cubic inches, cube the diameter in inches (that is, multiply it by itself, and then the product by itself), and multiply by ·526. Thus, the contents of a 7-in. ball equals $7 \times 7 \times 7 \times \cdot526 = 179\cdot6$ cub. in., and the weight of the ball is $179\cdot6 \times \cdot26 = 46\cdot8$ lb. The weight of cast iron per cubic inch varies from ·25 lb. to ·27 lb. A simpler method of determining the weight in pounds is to cube the diameter in inches and then multiply by ·136.

Solutions for Silvering Glass.—(*a*) Dissolve 60 grains of silver nitrate in 1 oz. of water, and pour this solution quickly into a boiling solution of 48 grains of Rochelle salt in about 1 oz. of water. On cooling, filter the liquid, and make up to 12 fl. oz. with distilled water. (*b*) Dissolve 60 grains of silver nitrate in 1 oz. of water, then add ammonia until the precipitate is nearly re-dissolved, and make up to 12 fl. oz., as before. For silvering, equal volumes of these liquids are mixed just previous to using. Another formula is: (*a*) Dissolve 48 grains of silver nitrate in 1 oz. of distilled water, and add ammonia till precipitate is nearly dissolved, filter the solution, and make up to 12 fl. drachms with water. (*b*) Dissolve 12 grains of Rochelle salt in 1 oz. of distilled water, boil, and add while boiling 2 grains of nitrate of silver previously dissolved in 1 drachm of water, cool, filter, and make up to 12 fl. drachms. Mix equal proportions as stated above.

Covering Circular Frames with Plush.—Take a circular piece of plush, 2 in. to 1½ in. larger in diameter than the frame, cut all round the edges to the depth of plush that will overlap the frame; lay the plush right side down on the table without creasing it, apply round the front of the frame a touch of glue, which must be strong and not watery. Then lay the frame on the plush, and strain it tight by pulling it with the hands; then by different stages apply the glue at the back and overlap the overhanging plush, taking 3 in. or 4 in. at a time (see A, Fig. 1). Press the plush into contact with the wood with a bone paper-knife or piece of wood. When completed and nicely set, with tailor's chalk draw a circle in the centre of the plush, then cut it out with scissors; leave a margin of 1 in. or ¾ in., so as to overlap on the rebate of frame. To get the circle easily, a dinner plate may be employed as a guide. After cutting out the circle

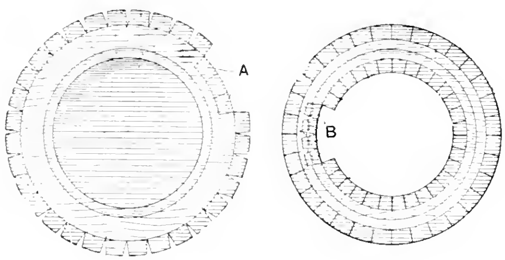


FIG 1 FIG. 2

Covering Circular Frames with Plush.

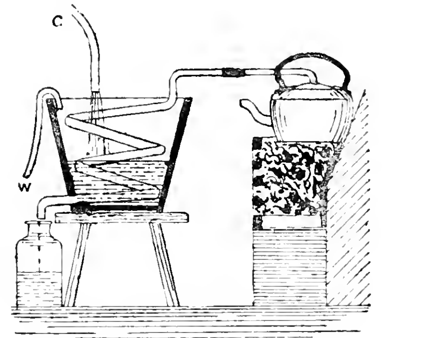
with scissors, cut the inner edge all round to the required depth. It requires great care not to cut too far, but just so that it will overlap and fit snug (see B, Fig. 2). Press it well into the rebate, a little at a time.

Selecting Portland Stone.—The chief points in the selection of Portland stone for building purposes depend upon the purpose for which the stone is required. There are four distinct kinds, of which three are usually sent into the market. The best is True Roach, 2 ft. or 3 ft. thick, consisting of a mass of fossils united by a cement composed of carbonate of lime, distinguished from Bastard Roach by its containing the Portland screw fossil; it is much used in engineering works. The Whitbed is the most useful Portland stone, consisting of fine oolitic grains, well cemented together, with a small amount of shelly matter at intervals. It is a good weathering stone, will take a fine surface and a sharp arris, and is used for the finest ashlar work. Basebed is very similar in appearance to Whitbed, but of a less roe-like texture when examined through a magnifying glass, and more free from shelly matter. Being more uniform in texture and softer to work, it is preferred by masons, but does not weather so well. It is useful for internal work and carving, and is generally known as "best-bed." All stone should be laid on its natural bed, but in Portland stone it is not so easy to detect this as in more laminated stones.

Making Marking Inks.—The only really reliable marking inks that will not wash out of linen, apart from stamping inks, are those that contain compounds of silver, gold, or platinum. Silver inks are indelible as long as the fabric lasts, but they become paler as the fabric wears away. Chloride of lime or eau-de-javelle bleaches silver marking ink, the action being to convert the black metallic silver into white silver chloride. The following recipes are for silver inks:—(*a*) Nitrate of silver 17 parts, ammonia 42 parts, carbonate of soda 22 parts, gum 20 parts, sulphate of copper 33 parts, distilled water 85 parts. Dissolve the carbonate of soda in 25 parts of water, the gum in 50 parts of water, and the nitrate of silver in 10 parts of water. To the solution of nitrate of silver add the ammonia and shake thoroughly; mix the solutions of gum and carbonate of soda and add to the silver solution; finally add the sulphate of copper and shake till dissolved. (*b*) Dissolve 2 dr. of nitrate of silver in 1½ oz. of water and add strong ammonia gradually until the precipitate which first forms is just re-dissolved, make up to 2 oz. with water, and colour with a little indigo extract, sap green, or any suitable aniline colour. It is usual to press a hot iron upon the marking so that the ink may decompose and the silver be reduced.

Making Gold Cardboard Mounts.—The openings or sinkings of cardboard mounts are cut from close-grained board made for the purpose. The surface of the cut-out mount is coated with gilders' thin matt size, which is made by mixing fairly strong size with the raw material. Generally two or three coatings will be necessary, each coat being allowed to dry thoroughly. The surface is next papered down with old emery-paper, washed, polished, and finally covered with English gold leaf. Much experience is required in this particular branch of gilding. The primary cause of failure is in getting the matt size and subsequent weak sizes too strong.

Apparatus for Distilling Water.—The still may be made from a large iron kettle and the condenser from a coil of tin pipe placed in a pail of cold water. In the kettle lid bore a 1-in. hole and solder into it a bent piece of pure tin pipe. Bore a 1-in. hole in the side of a wooden lard bucket and make a coil from three or four turns of the tin pipe; pass one end through



Apparatus for Distilling Water.

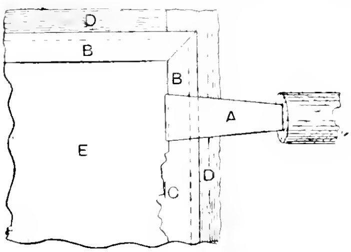
the hole in the bucket and cement it in with white lead. Stand the bucket on a stool so that the tin coil can be connected to the tube in the kettle by means of a small piece of rubber tube. The water to be condensed may be conveyed to the bucket by means of a small rubber tube or a length of compo pipe, and may be syphoned away from the top of the bucket by a bent piece of compo pipe. The kettle should be about three-fourths filled with tap water through the spout, which is then corked, and the kettle is heated on the fire or gas stove; the first small quantity of water which distils into the bottle should be thrown away and the distillation stopped before the residue is dry. For drinking purposes, the distilled water should be passed through a charcoal filter to aerate it. The sketch shows the distilling and condensing arrangement.

Making Purse Nets for Catching Rabbits.—Purse rabbit nets are square worked on a 2-in. mesh, using ten or twelve rows of the same number of stitches. Flax sewing twine, bought in skeins, is suitable. The draw line can be rove through all meshes round the net, and attached to a brass ring for pegging over the rabbit's hole, or a ring may be hitched to each corner and the line rove through the rings only, in which case the line is pegged over the hole and not a ring.

Removing Enamel from Mahogany.—To remove enamel from mahogany panels, take a bucketful of freshly made limewash and add 2 lb. of common washing soda. Apply to the panels with an old brush. Several applications may be necessary. As the enamel softens, scrape off with a wedge-shaped piece of wood. Swill off with plenty of clean water. Should this treatment turn the panels darker in tone than desired, the colour may be restored again by wiping over with oxalic acid, ½ oz. to 1 pt. of water. Swill off again with clean water, then wipe over with common vinegar to remove any trace of acid.

Transfer and Re-transfer Papers for Lithography.—To make yellow transfer paper, mix together equal quantities of best flake white and isinglass or gelatine, adding sufficient gamboge to give the required tint. Put the ingredients in water, and heat them over a slow fire until dissolved. Then strain the mixture through a piece of muslin to get rid of the coarser particles, and, while it is still quite warm, spread it, by means of a large flat camel-hair brush, on one side of smooth, thin paper cut to convenient sizes. The paper, when dry, should be passed through the press over a heated lithographic stone. To make re-transfer paper, mix in tepid water one part of best ground plaster-of-Paris with three parts of shoemakers' paste free from alum, adding a small quantity of dissolved patent glue. Strain through double muslin into a jar, and spread cool, with a flat camel-hair brush, on rather thick paper.

Replacing a Broken or Cracked Window Pane.—Knock out the old glass and putty. This can be done with an old knife worn down to about 2 in. or 3 in. from the handle. When the knife has made its way into the putty, keep it flat against the window frame and hit it with a hammer. Work all round the frame in this manner until all the old putty is removed, care being taken not to chip the window frame by driving in the knife too far. The putty being removed, get a little paint, and apply it all round the rebate of the frame, and after it has dried a little take some fresh putty in the right hand and press a thin layer round the frame with the thumb. Put in the pane of glass, press it evenly all round to bed it in the putty, and fix it on each side with two small tacks driven into the window frame with a light hammer, allowing the heads of the tacks to protrude about ¼ in. Putty the outside of the pane all round and bevel it with a sharp knife, resting against the edge of the window frame and on the glass in the manner illustrated, pressing the thumb against the side A. The figure also shows the cut putty at B, the uncut putty at C, a portion of the framing at D, and the window pane at E. The glazing is completed when the surplus putty on the inside has been removed. When ordering glass to be cut to size, first take the exact measurements of the window frame, and deduct $\frac{1}{16}$ in. from each edge, or ⅛ in. from two sides; thus: if the window frame is 12 in. by 9 in., the glass will be 11⅞ in. by 8⅞ in., so that if the glass or frame is not quite square the glass will still fit in, besides allowing the putty to bed against the edges. Putty can be softened with linseed oil, and is best kept in a can and covered over with the oil.



Replacing Broken Window.

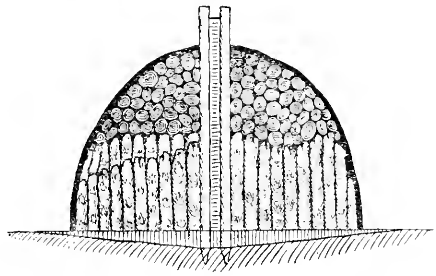
Vignetting Apparatus for Photographs.—The covers and bottoms of old plate boxes in which a hole with scalloped edges has been cut answer very well. They will stand some ¾ in. away from the negative—an essential in securing a soft vignette. The opening should be smaller than the size of the desired vignette, because the light spreads under the box. For head and shoulders, a pear shape is about the best; where thin portions of the negative occur under the vignette, cover with a piece of cotton-wool, pulling the edge loose. If the negative is thin or the light very bright, the whole should be covered with tissue paper.

Polishing the Panels of a Brougham.—After the carriage has the full amount of varnish on, it must stand by for at least four months for the varnish to get thoroughly hard; it may then be very lightly faced down with pumice-stone and water, and polished up with rotten-stone and linseed oil, using a rubber of some soft material. Should it have a dull look when finished, owing perhaps to too much oil being used, rub over briskly with a mixture of equal parts of vinegar and oil applied with a pad of cotton wadding.

Speeds for Turning and Boring Metals.—For turning cast iron the speed of the job past the tool may be 150 in. to 190 in. per minute; for wrought iron, 260 in. to 280 in. per minute; for yellow brass, 300 in. per minute; and for chilled rolls, 3 ft. per minute. In boring, the following speeds are recommended:—For cast iron, 80 in. per minute, and for wrought iron, 110 in. per minute. For screw-cutting in steel a suitable speed is 7½ ft. per minute; it, however, should depend on the nature of the material, Bessemer steel, for instance, being turned or screw-cut at a higher speed than cast steel. To determine approximately the peripheral speed of the job in inches per minute, multiply its diameter in inches by $3\frac{1}{7}$, or by 3·1416, and by the revolutions per minute.

Gilding Lines on a Boat.—To apply transfer gold leaf to gilt lines, rub the varnish down smooth and paint the lines to be gilded with equal parts of good oak varnish and japanners' gold size, into which has been worked a little powdered chrome or ochre. In about half an hour, when "tacky," apply the leaf; press in contact, and dust off the surplus with a camel hair brush when the whole is finished.

Converting Oak Branches to Charcoal.—When oak branches are so small that useful wood cannot be got out of them, perhaps the best way to utilise them would be to convert them to charcoal. Small branches are, however, not the best for making charcoal; large branches that can be sawn into 3-ft. or 4-ft. lengths are most suitable; they lie close, and there is not an excessive waste during burning. With small branches the labour of cutting up will be found to be very heavy; but if they were not cut up the branches would occupy very much space and the loss during burning would be heavy. The branches may be cut up and then stacked in a circular mound, as shown in the figure. First of all, three or four wood piles should be driven into the ground close together, so as to form a rough chimney. A ring should be marked around these piles, and four to eight shallow furrows should be ploughed in the ground from the edge of the ring to the central piles.



Converting Oak Branches to Charcoal.

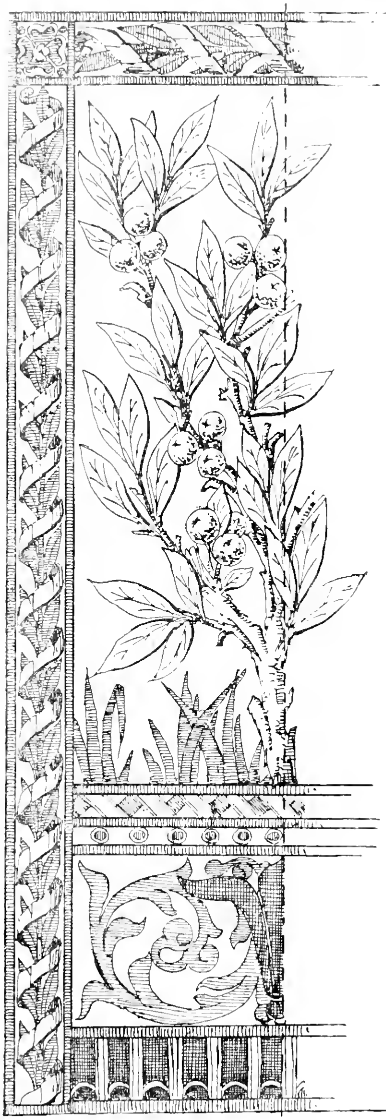
The wood may now be stacked around the piles and heaped closely till it forms a mound nearly as high as the piles and nearly as large as the ring. As a protective covering, the whole mound will now have to be covered with earth, turf, or wet clay. When this is finished, the central piles may be removed, and lighted brands placed in the mouths of the furrows, when the draught produced by the central chimney will soon cause the heap to ignite. The burning should be carried on slowly; when the heat becomes excessive, it may be moderated by placing a piece of turf over the furrow and damping the earth. When smoke ceases to issue from the chimney, turf or earth should be placed over the furrows, and the whole of the covering well damped. The pile should be allowed to cool somewhat before it is pulled down.

Cooling Air.—A simple method of cooling air which is drawn by a fan from the outer atmosphere is to make a frame and cover it with coarse canvas or cloth having large interstices, and across the top of the frame carry a pipe with small holes bored in it so that water can be made to trickle slowly over the whole of the canvas. The water could be cooled with a little ice if necessary. There must be a trough or channel to receive the water at the bottom of the canvas, and the frame must be erected to fit an opening so that the whole of the incoming air will pass through the canvas. Have the frame of good size so that the air will not be forced through it too swiftly.

Brush Polish for American Organs.—For a dull finish almost any kind of soft gum varnish is generally considered good enough; for a bright finish the following formula is recommended: Shellac 4 oz., sandarach 3 oz., Venice turpentine 1 oz., oil of turpentine ½ oz., camphor 10 gr., methylated spirit 1 pt. Carefully strain before use; apply with a camel-hair brush. The best results are obtained when the work is done in a hot room. When many coats are applied, sufficient time should be allowed for the undercoat to harden properly, otherwise "checking" or shrinking, causing a cobweb appearance, will be the result. This fault is not so apparent on dull as on bright finished goods.

Applying Gold Bronze to Picture Frames.—Mix the bronze with japanners' gold size and turpentine, and use it with a good body. The paint will never look equal to gold leaf; its durability will be increased, however, by coating with varnish.

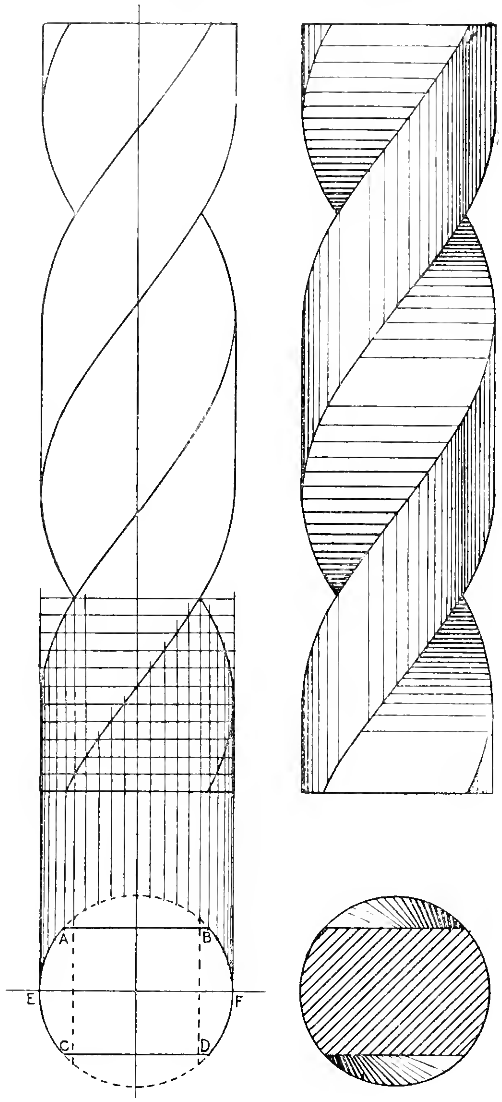
Door Curtain to Contain Autographs.—A suggestion is here given for carrying out a design of an autograph door curtain, to be worked with coloured silk on a cloth ground. The curtain is 8ft. long by 4ft. in width. The border is arranged to have a scroll of leaves on a stem, the leaves being worked all over so as to give



Design for Door Curtain.

a mass of dark colour. If the leaves are shaded green and the stems a rich brown a good effect will be produced. Winding round this wreath is a ribbon on which the autograph might be sewn; this will give a pretty appearance without detracting from the general artistic effect. The scroll across the upper section of the dado of the curtain is also arranged to take autographs. This dado should be filled in with dark masses of colour. The central portion of the curtain might contain the outlines and stems of the leaves worked in shaded silk, the branches being in shaded browns, and a little more fully worked than the leaves. The fruit might be in silk of a brighter colour so as to add brilliance to the composition. The leaves and fruit may be used for the autographs if required, that is to say if the spaces in the border and the top of the dado are not sufficient; but it is suggested that the autographs should be placed on the fruit first and then on the leaves, as the artistic effect will be better. The colouring must be left to the taste of the worker, and will depend much on the colour of the cloth adopted for the curtain.

Projection of Spiral Curves.—Assuming a parallel spiral, the method to be adopted is the same as that for the projection of a helix or single spiral line on a geometrical cylinder. The points A, B, C, D, in the accompanying illustration, when projected, give the



Projection of Spiral Curves.

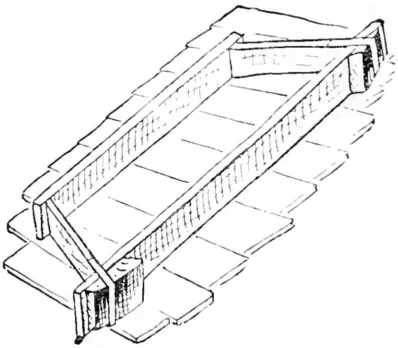
lines in the elevation, while points E and F give the diameter of the cylinder. The left-hand figure shows the geometrical outlines, and the right-hand figure the shaded result.

Gold-lining Picture Mounts.—To gold-line mounts for pictures, prepare a solution of strong gum arabic, and add a small quantity of moist sugar; strain through muslin. Placing a ruler where the line is required, with a quill make a full line of gum. In a few minutes the gum will become "tacky," and gold leaf, cut in very narrow strips, may be applied with a tip, dabbed down and skewed in in the usual way. This process will give a clean, durable line. Gold lines made by applying gold paint turn black in a very short time.

Keeping Water in Gas-holder from Freezing.—Mix the water with commercial glycerine, or use a solution of calcic chloride instead of water in the tank. The most practical way of getting over the difficulty, however, is to insert a steam pipe into the tank of the holder, and during frosty weather to pass steam through the pipe, taking care not to allow the temperature of the water to get too high.

Finishing Piano Cases.—Most varnished surfaces can be got to a dead level and brilliant gloss by first rubbing level with hair cloth or felt and finest-grade pumice powder, and bringing up the gloss with tripoli, crocus, rouge, or putty powder. All inequalities being removed, rub carefully with tripoli and oil, working with a circular motion till the surface is perfectly smooth and inclines to brightness. Wipe off all greasiness and well rub with dry putty and silk, and finally finish with flour, still using silk or the palm of the hand, which should be perfectly clean. It will require practice to find the most suitable varnish and the knack of imparting a brilliant gloss over the large surface of a piano.

Forming Concrete Window Sills and Heads.—Make wooden moulds, wrought inside, of the dimensions and shapes of the heads and sills, arranging one side to be removable, as shown in the sketch. Wedges driven through iron straps tighten up the mould when it is to be used. For the concrete, take one part by measure of Portland cement, one part of clean sharp sand, and three or four parts of broken stone, gravel, or broken brick of, say, 1-in. gauge. Turn these over on a boarded platform while they are dry, then, while water is being sprinkled on from a watering-can, turn the whole over twice or thrice, taking care not to use more water than is necessary to bring the cement and sand to the consistency of good mortar. The mould in the meantime should be coated inside with linseed oil or soft soap to prevent the concrete sticking. It is laid on a boarded floor, and the concrete is filled in and punned with a rammer to well fill the corners of the mould and to ensure solidity. Leave the concrete about 1 in. below the top of the mould, and float up this portion with a mixture of equal parts cement and sand, so as to form a skin of finer stuff for the surface that will be exposed to view. The mould must now be left undisturbed for two or three days, when the wedges may be knocked out and the window-head removed. Before being used, the latter should be stacked away for ten or twelve weeks—the longer the better—to bring out the strength of the cement. Sills can be made in the same way, but the moulds are a little more elaborate.



Forming Concrete Window Sills and Heads.

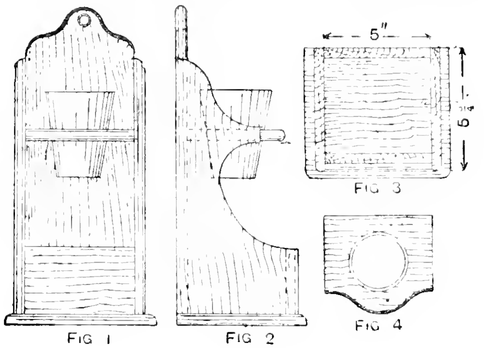
Yellow Finish on School Furniture.—To obtain the yellow or amber tone seen on chairs and stools used in schools and clubs, dark-coloured shellac is generally used if the articles are finished by French polish or spirit varnish. A more prominent colour may be gained by rubbing over with linseed oil and yellow ochre. For deal goods, size with patent size strongly tinted with yellow ochre or lemon chrome. For best-class goods the varnish may be tinted with gamboge or madder.

Testing Gaspipes and Fittings for Soundness.—The most satisfactory method of testing the soundness of gaspipes and fittings is to subject them to air pressure in excess of the pressure of the gas which will flow through them. All cocks having been carefully shut off, an ordinary pressure gauge is attached, by means of a piece of indiarubber tubing, to the nozzle of a gas bracket or pendant, and the cock turned on. Air is then forced into the main service pipe by means of an ordinary force pump provided with a stop-cock, until a pressure of about 4 in. or 5 in. of water is shown on the pressure gauge, when the cock in communication with the force pump is shut off and the gauge carefully watched. If all the fittings are sound, the level of the water in the pressure gauge will remain constant. If, on the contrary, there is the slightest leak, the liquid in the pressure gauge will gradually sink until it attains the same level in both limbs of the gauge.

Waterproofing Grey Millboards.—Dissolve 1 lb. of yellow soap in a gallon of warm water; also dissolve 1 lb. of alum in a gallon of warm water. Dip the millboard for a few seconds in the soap solution, and directly afterwards into the alum bath, and then allow to dry. Another method of applying the waterproof solution is to add the alum solution to the soap solution, collect the precipitate on a piece of muslin and dry it, then place it in a bottle and add a little benzoline; the alumina soap will gradually dissolve in this, and may be thinned with more benzoline so that it can be applied to the millboard with a brush.

Removing Oil-painted Letters from Glass.—Brush over the letters a strong solution of caustic soda, or a mixture of 2 parts of pearlash, 1 part of quicklime, and sufficient water to make it into a cream. Allow the liquids to remain on the glass for a few minutes, and then wash off with water. A second application may be made if the first does not remove the whole of the paint.

Making Soap Box and Tumbler Rack.—Any odd pieces of sound wood ¾ in. or ½ in. thick may be used to make the article illustrated, and the several pieces when cut out are put together with round brass-headed screws. The back board measures 11½ in. long by 5 in. wide, and the side pieces 12 in. long by 5¼ in. at the widest part. The tumbler rack is cut from a piece of wood 5 in. by 1½ in., and shaped as shown in Fig. 4, a round hole being cut in the centre to receive the tumbler. After all the pieces are cut to their proper shape, rub them well with sandpaper, and fix them together. Two or three coats of oil or varnish will help to preserve the wood from continual dampness.



A Soap Box and Tumbler Rack.

Preparing End Grain Wood for French Polishing.—Cabinet-makers finish the end grain of wood ready for polishing with a finely set iron-faced plane, and where this does not leave the wood sufficiently smooth the steel scraper may be used. Some cabinet-makers use glass-paper held tightly over a pad of cork, wiping over with glue water or polish to raise or swell the grain during the operation. As this dries out it binds the fibres together, thus producing a hard, dry, smooth surface.

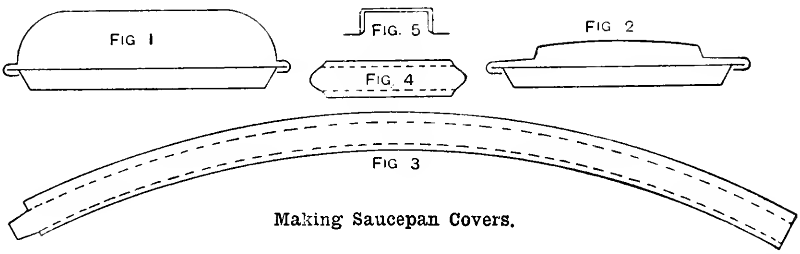
Making Stereotyper's Flong.—Flong may be made with two sheets of soft but tough matrix paper and four sheets of strong tissue, put together with stereotyper's paste. The paste recommended by an American authority upon stereotyping consists of 6½ lb. of Oswego starch, 2¼ lb. of wheat flour, mixed in 6 gal. of water until all lumps are dissolved. Add 12 oz. of common glue dissolved in 2 qt. of water, and 2 oz. of powdered alum. Boil, stirring constantly, until the mixture becomes sufficiently thick. Let it get cold; then take what is required for a day's use, and add one-half the bulk of powdered whiting. Incorporate thoroughly, and pass the mixture through a sieve having about twenty meshes to the inch. Lay one sheet of the matrix paper (previously soaked in water) on a smooth flat surface; cover with a thin layer of the paste, well rubbed in. Next lay on a sheet of tissue, and smooth it down with the utmost care, using either the hand alone or an iron roller. Then add paste and paper alternately until four sheets of tissue have been added to the two sheets of matrix paper. Backing paper may be added after the flong has been beaten into form. If placed under a wet blanket, the flong will keep good for several days.

Facing and Staining Picture Frame Mouldings.—Patent or glue size and best whiting mixed and spread on like paint is generally used; several coats may be given. Or plaster-of-Paris and whiting in equal parts could be used. When quite dry, smooth down with glasspaper or, better still, pieces of pumice-stone of various shapes to fit the hollows, rounds, etc., using a coat of thinned-out whiting and size as a lubricant, wiping off the surplus with rag and clean water. To stain black, mix a quantity of vegetable black or lampblack in 1 part French polish and 3 parts spirit. Then polish with ordinary polish stained an intense black by adding a small quantity of aniline black spirit dye.

Polishing Razors.—To remove from a hollow razor the marks caused by grinding, a glazer is required. This may be of wood only, or wood covered with leather on the edge, which must be dressed with emery of the various grades. The razor must be laid lengthways on the glazer. The polishing should be effected with crocus powder. The emery powder and crocus must be mixed with mutton suet to a thick paste.

Re-colouring Bronzes.—Imitation bronzes, made of spelter metal, may be restored by careful washing, polishing with soft chamois leather, and lacquering warm with best silver lacquer. Re-bronzing must be done by electro deposit. Real bronzes may be restored by completely covering them in the sand of a brass and copper foundry, taking them out from time to time at intervals of two or three days, and rubbing them with soft chamois leather. When the desired colour is obtained they may be lacquered with colourless lacquer; or if not lacquered, they will, if rubbed from time to time, improve in colour.

Making Saucepan Covers. — Saucepan covers of copper and tin are made in two shapes, as shown in section by Figs. 1 and 2. To make a cover like Fig. 1, bend a thin strip of metal to the shape of the section; this strip of metal when straightened out flat will give the diameter of the circle for the cover in the flat. If a number of covers of one diameter are required, they are usually hollowed in "tacks" of four or six, according to the strength of the material. A wood block containing a slight hollow and a bullet-faced hammer are required. Hold the edge of the covers over the hollow in the block, and, using the roundest face of the hammer, drive the metal down to the hollow, working round the edge with regular blows, and continue working round in a series of concentric circles towards the centre until the cover is hollowed to the desired height. Again commencing at the edge, with light, regular blows, go once more over the hollowed surface until it is smooth. Now separate the covers, and, with a burring machine, throw off a flange proportionate to the size required (usually about ⅜ in. to ½ in.). The cover shown in Fig. 2 is begun in the same way as Fig. 1, but when hollowing it is pitched up in a deeper hollow with the heel of the hammer, or with a hammer specially made for the purpose, until the ridge shown in the illustration is formed and the outer edge is left all puckered. Assuming that the cover is to be finished without the use of a swage, the edge on the top of the cover should be worked up sharp with a mallet upon a bright round head; then form the side of the ridge, worked round carefully, with a square-faced hammer (the front edge of which has been rounded off) upon a bevel stake. The outer flange may then be thrown off upon a bright anvil, using a mallet to remove the puckers, and a round-faced bright hammer to work it down to the shape. The cover should then be planished smooth and true, and the top also planished to finish it. From this point the working of both covers is the same. Cut from an arc of a circle, equal in length to the circumference of the body the cover is to fit, a rim about 1 in. deep, with allowances for flanging and edging, as shown by Fig. 3; then work over an edge along the dotted line on the inner curve, and flatten this edge down so as to stiffen the rim. Turn the rim round, fit it to the body, and solder it together at the ends. Then, with the burring machine, throw off a flange along the top edge of the rim. Now with the same machine take up on the covers an edge of such a size that the flange of the rim will fit into it. Pene down the edge of the cover upon the flange of the rim. Cut out a handle as shown in Fig. 4, wire it along both edges, bend it to the shape shown by Fig. 5, and rivet on.



Making Saucepan Covers.

Background for Photographic Portraiture.—For a background for full and three-quarter length portraits, a light bluish grey is the best colour. It should not be a flat tint, but graduated with soft clouds of various shades. To make such backgrounds requires considerable skill. As a makeshift for occasional work, the sheet may be stained with coffee to a light brown. If it is to receive a flood of light, it may be darker, and if in the shade, lighter. The exact tint is best found by experience. Or Maypole soap may be used, in which case an orange yellow should be chosen. In any case, the background should be stretched tight on a frame or suspended from a roller with a rod at the bottom. Creases are very objectionable.

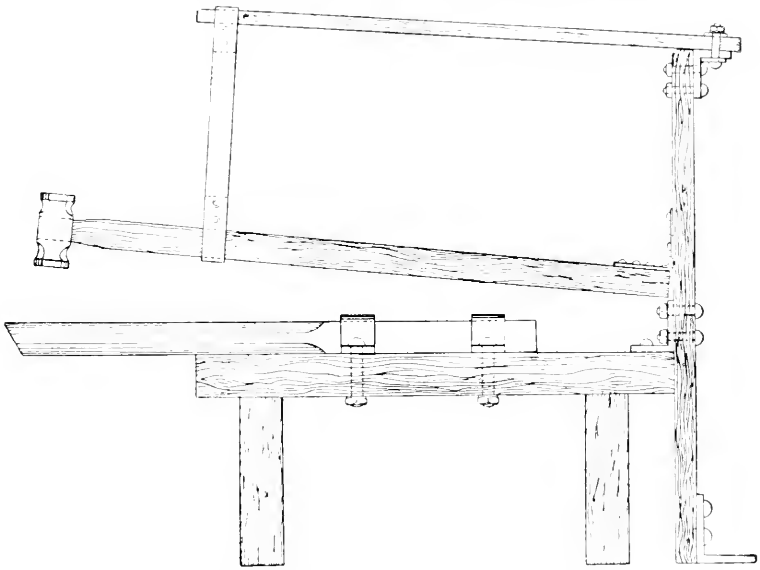
Making a Plaster Relief from a Photographic Negative.—To make a bas-relief in plaster-of-Paris from a photographic negative, the process briefly is as follows:—Soak a sheet of No. 4 gelatine in a solution of bichromate of potash, made by dissolving 1 dr. of bichromate in 6 oz. of water; allow this to dry slowly (generally taking twenty-four hours) in contact with waxed or French-chalked glass. The glazed surface thus obtained is placed in contact with a suitable negative, that is, one containing considerable contrast combined with good gradation, and exposed to the light. In half an hour, or in five or six hours, according to the strength of the light, a faint image will have been printed on the gelatine. When printed, the gelatine is firmly cemented to a sheet of glass with isinglass or other powerful adhesive, and allowed to soak in cold water for about six hours, afterwards soaking for a further time in a 1 in 4 solution of citric acid, and finally in water. When the utmost possible amount of relief has been obtained, the superfluous moisture is carefully removed with the edge of a blotting board, and oil is poured over the gelatine mould, and then drained off. The gelatine relief is then placed in a dish, and the plaster poured over it and allowed to set, after which the relief may be pulled off. The relief thus obtained is generally rather false owing to differences in colour—particularly if isochromatic plates are not used—being grossly exaggerated. Much may be done by skilful retouching.

Gold Veins in Book Edge Marbling.—The gold veins in marbled paper, or on the marbled edges of books, may be produced as follows:—Let the rest of the marbling be thoroughly dry. Then beat well together 1 part white of egg, 1 part spirit of wine, 2 parts water. Let the mixture get clear, then wet a small portion of gold powder (shell gold will do), mixing well with the finger, and apply with a small camel-hair pencil. Let it get thoroughly dry before burnishing, which should be done with a polisher made only moderately warm. The beginner should make several experiments before proceeding with the actual work.

Waterproof Dressing for Overalls. — Unbleached calico or drill sheeting is generally used for making overalls; all the seams should be double seam. For a dressing, really good boiled oil is perhaps the most durable, though some sailors prefer raw oil, but both take a long time to dry and are apt to become sticky. The following is safer for oilskins not in constant use: boiled oil 8 parts, turps 2 parts, and melted beeswax 1 part. Warm the oil, add the wax, stir in the turps, and apply warm. The first coat must be well rubbed in. In an hour or so wipe off any surplus that may have drained down to the lower edge. When thoroughly dry, add equal parts of boiled oil to the former mixture, and lampblack or ochre as desired. With this paint give the material two more coats, letting each dry thoroughly in a cool, shady place.

Remedy for Smoky Chimney.—The most prolific cause of smoking with open ranges is the large open space that exists over the range and forms the mouth of the chimney. The draught in these ranges is not very keen at the best, and the large area allows quite cold air to rest there and to pass freely into the chimney, with the worst possible results on the up-draught of smoke and heated air. This is overcome by the use of a blower, which is a sheet of metal carried across the front of the range opening at the top, from jamb to jamb of the mantelpiece. This causes all air entering the chimney to come closer down to the fire and receive warmth, for while cold air impedes the up-draught, hot air accelerates it. A cranked metal pot will often prevent the down-draught, whilst a blower will stop the general smoking. The blower can be made temporarily of cardboard or paper to find the depth required.

How to Make a Metalworkers' Mandrel Dolly.—A mandrel dolly is made by first fixing the mandrel securely to a strongly made bench, by means of iron clamps passing over the square end of the mandrel, and holding them in position by nuts and bolts, as shown. On the end of the hammer shaft an iron hinge is fixed, and when this is done, the hammer should be held flat and true in position upon the mandrel, and the position at which the vertical part of the hinge is to be fastened to the upright carefully marked. Then secure the hinge in the required position. Now fasten a stout lath of ash, to act as a spring, at the top of the upright beam to an iron bracket, as shown, and over the opposite end of the lath fasten a leather strap; then fasten the lower end of the strap round the hammer shaft, so that the hammer is held suspended about 8 in. above the work. When using the hammer, grasp the shaft close to the hammer head, and swing it down against the resistance of the ash lath to produce a blow upon the mandrel.



How to Make a Metalworkers' Mandrel Dolly.

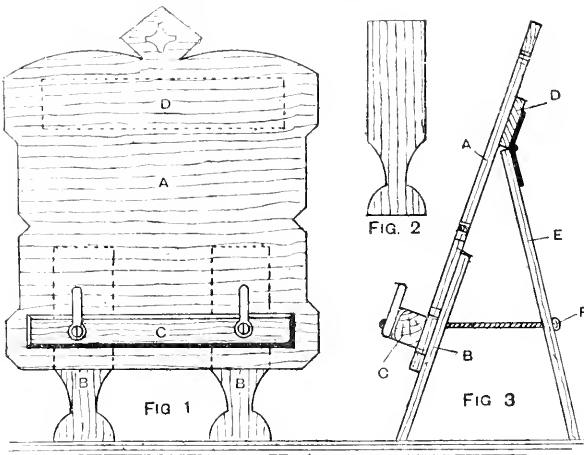
Paste for Laying Linoleum and Oilcloth.—To make cheap flour paste suitable for laying linoleum and oilcloth, mix rye flour with a little cold water, then add *boiling* water, well stirring the paste while the water is being poured. Melt some glue size and add to the paste while both are hot. Stir well. The more size is added the greater the strength of the paste. As a rule, "Inlaid" linoleums require very strong paste. A little alum dissolved in the paste is a preservative. If the paste is too thin, boil it, to evaporate some of the water.

Converting Bacon Cuttings into Soap.—The fat is first rendered in a large cylinder with an inlet for steam, exits for water and melted fat, manholes for charging and withdrawing fat, a false bottom for the latter to rest on, and a safety valve weighted to a pressure of two or three atmospheres, that is, 30 lb. to 45 lb. per square inch. The rendered fat is then run into cold water and removed for soap making, which is usually carried out in immense pans heated by fire and steam, either alone or together. The amount of materials put in the pan should not more than two-thirds fill it, so as to allow of frothing. The lyes are made by adding caustic soda to water. Two lyes are often employed, and usually three, one at 10 Tw. (4 per cent.), one at 16 Tw. (6½ per cent.), and the other at 24 Tw. (8¾ per cent.). The fat is run into the pan, and the weaker alkali is gradually added while boiling; the stronger alkali is then added, and the mass boiled for several hours until clear. The pan is then allowed to settle, salt added, and, after thorough stirring, the waste lye may be run from the bottom of the pan. The strongest lye may now be added gradually, boiling and stirring thoroughly until the soap boils clear; then allow to settle again, and run off the soap into frames, taking care that any waste lye at the bottom does not go along with it. The strength and amount of the different lyes vary, but on the average 15 lb. to 16 lb. of caustic soda are employed for 100 lb. of fat.

Stitching a Square Edge to the Cushion of a Couch.—To stitch up the front edge of a couch seat so as to procure and retain a fine point, the tools required are a double-pointed 8-in. mattress needle, a regulator, which is something like a broad flat packing needle, and a ball of strong twine. Insert the regulator about 1 in. from the front edge of the seat, and work the flocks, or whatever the stuffing material is composed of, well up to the edge, pricking the regulator in about every 6 in. The first stitch is known as the blind stitch, as it cannot be seen on the top of the seat. Thread the needle with twine, pass it through the front a little below the stuffing rail, and out at the top of the seat about 1 in. from the front edge. Without pulling the needle right out, back it out again on the front 1 in. beyond the point at which it was first inserted. Repeat this operation along the whole of the front, pulling the stitches tight; that will draw all the flocks within the stitch on to the front edge of the stuffing rail. Now insert the threaded needle again about ½ in. higher than the last stitching; pass it through the top of the seat, and re-insert it about 1 in. farther on, stitching through backwards and forwards, letting the needle come out midway between the last stitches; pull the stitches up tight, and repeat the process as often as necessary, every row of stitches coming nearer the edge, until a fine point has been obtained. The edge, when finished, is similar in appearance to two or three coils of rope. Should the edge be very soft, or give in the middle, the stitches will be found to be slack or the rolls not stuffed firm enough. Take particular care to use the regulator before every row of stitches.

Cement to withstand Paraffin Oil.—Glue is one of the best materials for withstanding paraffin or any other oil. Another cement is made by dissolving 1 part of caustic soda in 5 parts of water, and boiling with 3 parts of resin till dissolved. Afterwards stir into it about half its weight of plaster-of-Paris or chalk, and use at once, as it hardens rapidly. This cement would take the place of red lead or white lead. Common yellow soap is also recommended for withstanding paraffin.

A Table Book-rest.—Procure a board 13 in. wide and $\frac{1}{2}$ in. thick, planed smooth and as free from knots as possible. A piece 15 in. long, shaped as shown in Fig. 1, forms the board A (Figs. 1 and 3). The star at the top of the board may be cut with a fret-saw. Rub with glass-paper and make all the edges quite smooth. Cut two pieces 8 in. by $2\frac{1}{2}$ in. for the feet, and shape as shown in Fig. 2. When smoothed, screw them to the back of the board, in the position indicated by the dotted lines, at B (Fig. 1); see also B (Fig. 3). Procure a piece of wood 11 in. long by $1\frac{1}{4}$ in. square for the rest C (Figs. 1 and 3), bevel the edges as shown in Fig. 1, and secure it to the front of the board by screws put in from the back. Procure two pieces of sheet brass 2 in. long by $\frac{1}{2}$ in. wide, and about $\frac{1}{16}$ in. or $\frac{3}{4}$ in. thick. Drill a hole about $\frac{1}{2}$ in. from one end of each strip, file the strips to the shape shown in Fig. 1, and screw them to the rest with round brass-headed screws. Cut one piece of wood 10 in. by 2 in., and screw it to the back of the board 3 in. from the top, as indicated by the dotted lines at D (Figs. 1 and 2). Cut another piece of wood measuring $12\frac{1}{2}$ in. by 3 in. for the support E (Fig. 3), and secure it to the centre of the cross-piece D with a $1\frac{1}{4}$-in. back-fold hinge, as shown in the illustration. Procure a piece of fancy cord, secure one end to the board, insert the other end in a small hole bored through the support, and make a knot to keep it in place, as shown at F (Fig. 3). Make all the edges and corners quite smooth. The book-rest will look very well indeed if made of walnut and finished by French polishing. When in use, it is placed upon a table, and the support adjusted by means of the cord.



How to Make a Book-rest.

Regilding Soldered Joints of Plated Goods.—An electro-gilding solution made as follows is required: Dissolve 1 oz. of potassium cyanide in 1 pt. of distilled water made hot in an enamelled iron saucepan; suspend in this two strips of pure gold attached to copper wires and connect to a battery of two Bunsen or Daniell cells for an hour or more. Remove the strip of gold attached to the zinc element of the battery, and substitute a strip of silver. If this takes a nice gold colour, the solution will be fit for gilding. If not satisfactory, pass the current through the hot solution until it will gild properly. The cost of cyanide and water will be only a few pence.

Ascertaining Flash Point of Oils.—The flash point of oils is determined in two ways—by the "open test" and by the "close test." By the first method a small porcelain or metal dish is partly filled with the oil and placed on a sand bath heated by a burner; a thermometer suspended with the bulb in the oil registers the temperature. As the temperature rises a lighted taper is quickly passed over the surface of the oil, and when a faint vanishing flame is noticed, the temperature is read off; this is the flash point. For the close test method the apparatus devised by Prof. Abel is employed; this is fully described in the Petroleum Act of 1879. The apparatus is really a jacketed copper water-bath heated by a burner; the oil is contained in a small cup fitting into the lid of the bath, and there are thermometers in the bath and oil cup. The oil cup is covered with a lid and a slide, and hinged to it is a small spirit lamp. When the slide is drawn out the spirit lamp is tilted over the oil cup so that the flame is right over one of the holes in the lid, and on replacing the slide the lamp assumes its vertical position again. The testing is done by drawing the slide, which brings the spirit lamp in contact with the vapour from the oil cup; when flashing occurs the temperature is noted on the thermometer immersed in the oil. Water is used in the bath for oils which flash below 100 C. (212 F.), but for oils which flash above that temperature mercury must be employed.

Heating Cylinder from Two Fires.—A breakfast room grate and a kitchen range, if the two fires are back to back, can be utilised to heat a cylinder. There must be a boiler in each fire, the saddle boiler in the range being connected to the cylinder in the usual way, and the boiler put in the grate fire will be connected either to the pipes from the range boiler or independently into the cylinder. By this arrangement either boiler will do all that it is capable of doing towards heating the contents of the cylinder, and they will work separately or together without trouble, and without the use of stop-cocks or anything of this kind. No alteration is needed to the flues of either stove.

Use of the Optical Square.—This is an instrument 2 in. diameter by $\frac{3}{4}$ in. thick, to be held in the hand and arranged as shown in the accompanying figure, in which A is the sight hole where the eye is placed, B and C are openings in the rim through which rays of light can enter from poles at D and E, only farther off; F is a glass half silvered and half plain, the junction line being in the plane of the instrument; G is a whole mirror. In using the instrument for sighting poles as shown, it would be held in the left hand; with the eye at A, the pole D would be seen through the opening B and the plain part of the glass F; the observer being at the point where a right angle would be measured between D H, E H. Rays of light from pole E will reach mirror G and be reflected from there to the silvered part of glass F and thence to the eye at A, so that the glass F will appear like Fig. 2, the piece of pole J seen by direct vision being exactly over the piece of pole K seen by reflection. If in using the instrument the poles do not coincide, the station of the observer must be shifted until they do, or as an alternative one of the poles must be shifted. If the poles appear to coincide at the junction of the glasses but not to be in a straight line, it will be due to one of the poles being at a higher level than the other.

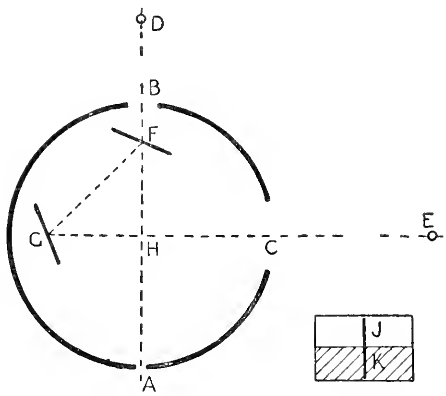


Fig. 1 *Fig. 2*

An Optical Square.

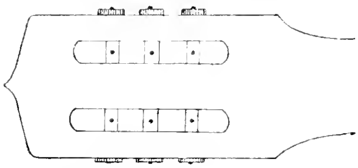
Making Blowers for Register Stoves.—Commence hollowing the semicircular blower by working round the circular part with a series of regular blows from a bullet-faced hammer, and holding the edge of the metal over a shallow hole in the hollowing block. This will curve the metal to a slight depth round the edge. Then bend the metal about 1 in. from the edge along the straight part, so that it makes a sharp angle; this will keep the bottom stiff while the remainder of the hollowing is done. Now commence on the circular part again, and work round from the edge in towards the centre, in a series of concentric circles, working it in a deeper hole if necessary than that used for commencing in. When the blower is hollowed to the depth necessary, go over the hollowed part again with a series of light regular blows until it is rendered smooth. Knock out smooth the break along the bottom, and then bend the ends round to the same curve as the hollowed part. A few blows from a flat-faced hammer, delivered upon the centre or flat part of the blower, may be necessary to set it so that it will be free from twist.

Value of Gold and Silver.—Gold has a fixed market value per ounce which never alters. Pure gold (24-carat) is worth £4 5s. per ounce troy; 22-carat gold (guinea gold or wedding-ring gold) is worth £3 17s. 11d. per ounce troy; 18-carat gold is worth £3 3s. 9d. per ounce; 15-carat gold, £2 13s. 1½d.; 12-carat gold (half gold, half alloy), £2 2s. 6d. per ounce; 9-carat gold (the lowest quality that is hall-marked in England) is worth £1 11s. 10½d. per ounce. The value of silver fluctuates according to the market; it has been worth 5s. per ounce troy, and it has fallen to 2s. The London market value of silver will be found in most daily papers under the heading "Market Reports," amongst the "London Metals."

Cause of Clicking Noise in Hot-water Pipes.—The clicking noise that proceeds from hot-water pipes after hot water has been drawn is caused by the expansion of a pipe (or pipes) when suddenly heated. If the pipe is cold, as is probably the case, before water is drawn off, it becomes suddenly hot when a tap is opened, and begins to expand lengthways. Wherever the pipe is so tightly fixed that free expansion is impeded, the resistance is overcome with a little jerk that causes the clicking noise. Pipes laid under floors across joists, where notches are never cut very deep, often give out the noise described. The same thing sometimes happens with circulating pipes as well as branches, though, in this case, it may be the sudden cooling and contraction of the pipes that cause the noise.

Purple Stain for Wood.—To make a purple stain, obtain 1 lb. of logwood chips or ¼ lb. of logwood extract, ¼ lb. of pearlash, 2 oz. of powdered indigo, and 3 qt. of water. Boil the logwood till the full strength is obtained, then add pearlash and indigo. The stain may be used hot or cold.

Fitting Worm Screws and Raised Frets to a Banjo.—To fit worm screws and raised frets to a banjo, get a pair of plates with machines fitted, and adapt them to the head of the banjo by squaring the "scalloped" sides and slotting the present holes quite through, similar to the sketch. Raised frets are fitted by making a "saw cast," putting in a little powdered shellac, heating the fret-wire, and pressing it into place. Specially prepared fret-wire can be obtained for the purpose.



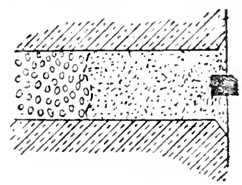
Fitting Worm Screws to a Banjo.

Varnish for Cork Frames.—For a varnish suitable for cork frames intended for indoors, there is nothing to equal spirit varnish, which consists of methylated spirit 1 pt., shellac 4 oz., and resin 2 oz.; it dries quickly and gives a glossy finish; a cheap quality will do. Apply in a warm room, and well stipple it in all crevices. Thin out with spirit for the first coating, but use it thicker for the second or finishing coat.

Roughcasting Walls.—The walls are first plastered with lime and hair mortar, having, for the best class of work, some cement added to improve it. After this has set, a second coat of mortar, mixed so as to be fat, is spread as evenly as possible over the last coat, and while this is quite soft the stones to be used are dashed forcibly against the work, to which they adhere. Care should be taken to see that the sand and stones or pebbles used are free from dirt, and if any clay is found mixed with the sand it will require washing. The stones should be screened so that they will be of about the same size. Sometimes a coat of lime-white and sometimes ochre is used for colouring the roughcast.

Felling a high Chimney Shaft.—To ensure that the stalk shall fall in a narrow compass, it will be desirable to fix three guy ropes from the top, equally divided round the circle, and made fast at a distance from the base of the shaft at least equal to half the height. Openings should be cut in the brickwork of the base on opposite sides, and 9-in. by 9-in. studs inserted, about 4 ft. long, between 9-in. by 3-in. plates running through the thickness. Before making the openings, 9-in. by 3-in. raking shores both ways should be fixed at each corner of the base. Two openings in each side, with a brick pier left between, would, in the writer's opinion, be required; and when this is done, if there is no sign of cracking or settlement, and the studs are taking a good bearing, the intervening pier in centre of each side may be cut away. Everything must be done systematically, working at opposite sides in turn. Waste wood should then be piled round the base in sufficient quantity to ensure that the wood studs will be burnt through, and lighted at several points. A couple of look-out men during the operations should be posted sufficiently far off to command a view of the chimney from two directions at right angles, and near enough to warn the men if any signs of premature falling were to occur. Local circumstances and the construction and condition of the chimney stalk may render some variation on the above method desirable. A cheaper method, and one that would probably be satisfactory in the hands of an expert in explosives, would be to explode a small charge of dynamite in the bottom of the shaft, or to bore holes round the base and insert charges of gunpowder, to be fired simultaneously.

Tuck Pointing Brickwork: Methods and Materials.—The ordinary process of tuck-pointing is as follows. The joints of the work to be pointed are raked out to the depth of ⅜ in., then filled in with stopping. If the stopping is not coloured, all the work is rubbed over with a soft good-coloured brick, so that the joints may look like the face of the bricks. A small groove is formed along the centre of the joint, and, the mortar having been allowed to set a little, this groove is filled up, for white tuck pointing, with white lime putty, till a raised line of putty projects beyond the face of the joint (see illustration). The edges of the white line are cut perfectly parallel by the pointing knife held against a straightedge, and drawn along so as to remove the superfluous putty, leaving a line, about ⅛ in. to ¼ in. in width, standing out beyond the face of the work as far as it is possible to make it. This gives the work the appearance of being a good piece of brickwork, executed with square-edged bricks and clean white joints. The effect, however, does not often last long, the first sharp winter usually playing havoc with the projecting joints. If the pointing is to last, it is better to use the ordinary weathered joint executed in cement.



Tuck Pointing.

White lime putty is made of pure lime slaked with water and strained off while hot (the consistency should be about that of cream); it is then mixed with washed silver-sand—but a better material is marble dust—in the proportion of 2 or 3 of sand to 1 of lime. Blue pointing mortar is made by using sifted cupola or forge coal instead of sand, and black pointing has lampblack added to the other materials. Small sections at a time should be prepared for pointing, for if the mortar is allowed to set hard, a groove for the white line will be difficult to make. To colour the work for yellow bricks, use 1 lb. of green copperas to about 5 gal. of water; for red bricks, 1 lb. of Venetian red and 1 lb. of Spanish brown to 1½ gal. of water; the quantity of colour must be varied according to the tint required.

Watch Carried in the Pocket Losing Time.—All watches (except extremely fine ones) lose to a certain extent in the pocket and go faster when lying horizontally, the difference varying from thirty seconds to one minute per day. It is caused by the more free vibration of the balance when poised on the end of one pivot only than when resting on the sides of two pivots, as it does when in the pocket. If the difference in a watch exceeds one minute per day, most likely the balance is not truly poised—that is, it is heavy at one point of the rim—and acts more or less as a pendulum when the watch is vertical. To remedy it, remove the balance and take off the hairspring. Then place the balance with its pivots resting on two finely polished straightedges, on which it can roll freely and be tested for poise, any fault being corrected by means of the screws in the rim (if it has them) or by filing, if it is a plain balance. Poising tools are sold for this especial purpose.

How to Make Silver Bronze Powder.—The best silver bronze is made by mixing silver leaf with honey or gum water, and grinding to powder in a mortar, after which the powder is washed with water and dried. For a common silver bronze, melt together 1 lb. of bismuth and 1 lb. of tin, and add ½ lb. of mercury. Pour the amalgam on to a cold surface and grind to powder in a mortar. Another form of silver bronze is simply pulverised white mica.

"Marine" Glue.—Marine glue is made from 1 part of indiarubber (cut into shreds) and 12 parts of coal-tar naphtha; these are kept in a bottle in a warm place and shaken from time to time till the rubber is dissolved; then 20 parts of powdered shellac are added, and shaking is continued until the mass becomes pasty. It is then poured on to a cold surface, allowed to solidify, and then broken up into small pieces, which should be melted and applied as thinly as possible while still warm. Great care must be taken in making this cement, as the naphtha is very inflammable.

Making a Child's Chair.—The strong useful chair illustrated below is suitable for children in their teens, and will stand wear and tear for a great many years, provided it is made from a hard wood. All the spindles can be made with spokeshave and plane, and also the top for the back and seat if desired; or they can be obtained cut to pattern for a few pence extra from any timber merchant. For the seat, a piece 16 in. by 12 in. by 1½ in. is required, cut to the shape shown at Fig. 3. The underneath part can be left in the rough. Bore through it fifteen holes ⅝ in. diameter in a slanting direction, at distances given on Fig. 3. Into the holes at the sides fit eight spindles 10 in. long (9½ in. when trimmed flush), ⅝ in. diameter, tapered at the ends so as to fit tight in the holes made for them; these spindles form sides for arm-rests. For the arm-rests two pieces are required, 12½ in. long, 1½ in. wide, and ¾ in. thick, cut to

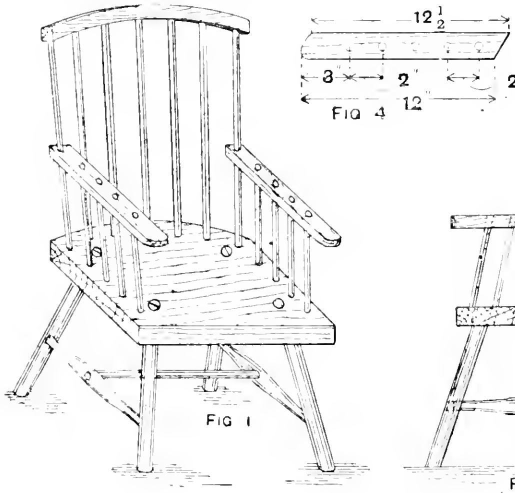


FIG 1 FIG 4

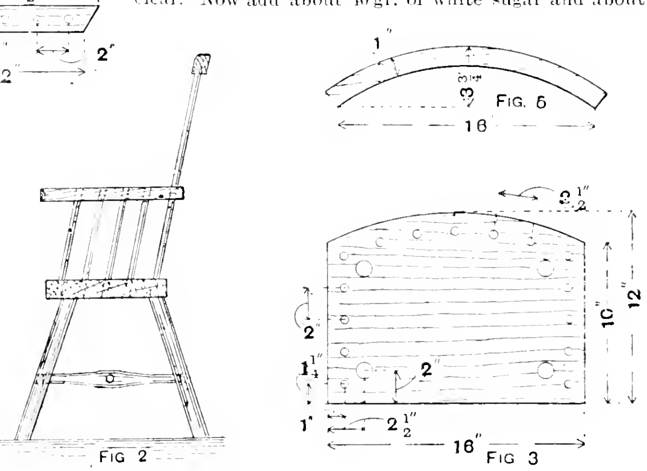


FIG 2 FIG 5 FIG 3

How to Make a Child's Chair.

the shape shown at Fig. 4; through these are bored five holes, four holes ⅝ in. diameter, and one hole ¾ in. diameter, at distances shown on Fig. 4, starting from the front part of the arm into which the spindles fit. The top for the back is cut from 1½-in. wood to the shape and measurements shown at Fig. 5, and has holes bored half-way through to receive the back spindles, of which seven are required, 20 in. long, ⅝ in. diameter, and tapered at the ends to fit into ⅝-in. holes. For the legs four pieces are required, 15½ in. long, 1 in. diameter, and tapered a little smaller at the top to fit in the holes made for them in the seat, which should be ⅞ in. diameter. Fitted in the sides of the legs are two spindles, 10½ in. long and ⅞ in. diameter in the centre, tapered at each end to ⅝ in. diameter; into these is fitted across a spindle 15 in. long and ⅞ in. diameter. Before fitting the legs into the seat, fix the spindle into the legs, and then the legs into the seat; the legs are 14 in. long when trimmed flush with the seat; also trim the back and arm spindles flush. The arm-rests must be fitted on before the top of the back, so as to allow two of the back spindles to pass through the ends of the arm-rests. Then fit on the top of the back, and the chair is ready for decoration by paint or enamel. The measurements could be altered so as to make the chair suitable for an adult.

Cleaning Sheet Brass after Annealing.—Large sheets of brass should be annealed in a properly constructed muffle or furnace; small pieces may be done in an open fire of cinders or small coke, not too hot. Heat the plates to a dull red heat in the dark, and leave to cool off. They require careful watching, or they will burn. Some brass plates, after being rolled, annealed, and washed in sulphuric acid and water, have a red scale left on them. The scale can only be got rid of by grinding on a large stone, or otherwise by the use of pumice-stone and water, followed by dressing off with Tam-o'-Shanter stone. For cleaning up after firing, try a solution of about 1 part of nitric acid in 6 parts of water, slightly heating the brass before plunging it in, leaving for a minute or two, then brushing with a stiff worn-out brush, and finally washing in clean water and drying in hot sawdust. The solution may be bottled and used over again, adding a little fresh acid from time to time.

Strength of Sheet Iron Water Tanks.—Rectangular tanks are tested as follows: $\frac{1}{16}$ in., 10 lb.; ⅛ in., 5 lb. per square inch. The corresponding values for cylindrical tanks are 40 lb. and 25 lb. per square inch. The cylindrical shape is almost invariably used when the pressure exceeds about 12 lb. per square inch. The resisting powers of all tanks that are not spherical or cylindrical are increased by the use of internal stay-rods.

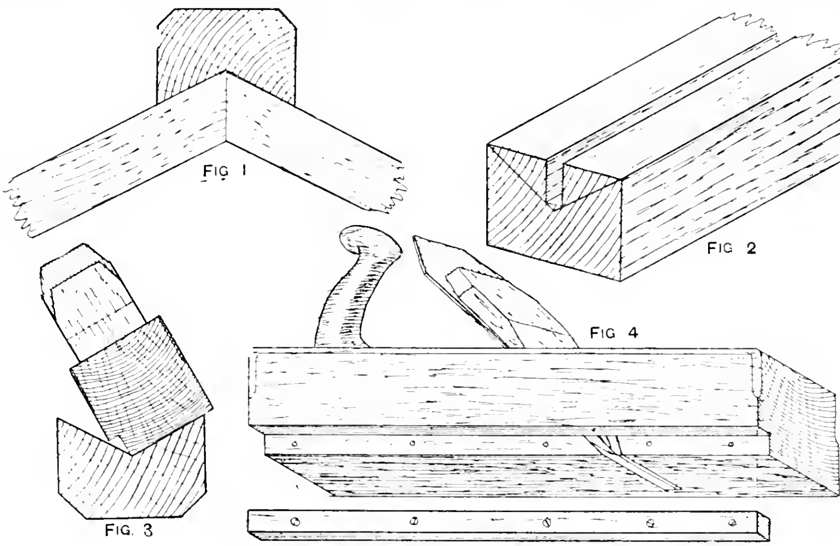
Photographic Mountants.—The best of all photographic mountants is starch. Place a teaspoonful of crushed starch in a teacup and mix into a thin cream with cold water, then, whilst stirring, add boiling water till the starch thickens. Allow to cool, remove the skin from the top, and the starch is ready for use. When more than two days old it does not answer well. The following have also been recommended, and will keep a considerable time. No. 1.—Dissolve 1 oz. of white dextrine in 3 oz. of water, add 1 oz. of powdered starch, and strain; then warm until the solution becomes clear. Now add about 10 gr. of white sugar and about half a dram of a 10 per cent. solution of carbolic acid. No. 2.—Soak 1 oz. of gelatine in 4 oz. of water for an hour or so, then add ½ oz. of chloral hydrate, keeping the solution hot during this addition. Or a good plan is to dissolve the chloral hydrate in a portion of the water, and then add whilst hot. A few drops of a saturated solution of carbonate of soda should be added to render it faintly alkaline. This mountant is extremely adhesive and does not penetrate the paper, so that it is specially suitable for mounting glazed prints, which lose some of their brilliancy when the mountant is very wet.

Chemical Fire Engine.—The chemical fire engine is fitted with two tanks, one of which contains a solution of bicarbonate of soda and the other sulphuric acid. By allowing the acid to flow into the bicarbonate, carbonic acid is evolved, and the pressure induced forces the liquid through the hose pipe. When the liquids are mixed there is present a solution containing sulphate of soda holding carbonic acid in solution, and this has been found very effectual in putting out fires.

Preparing Moonlight Scenes for Diorama.—The high lights should be cut with a sharp knife, each cut being horizontal, and from 1 in. to 3 in. in length. Take care the cuts do not run into each other. The path of the moonlight across the water should be cut thickly and close, especially at the horizon, getting broader as the bottom of the picture is reached. A few cuts to represent ripples about the other part of the water will give a nice effect. A good light must be placed behind the picture, the light in front being very dim. For a small subject there is no necessity to cover the cuts with gauze; the movement of the painting as it travels along will give the shimmering effect.

Lens for All-round Photographic Work, etc.—For all-round work with a whole-plate camera, procure a rapid rectilinear of about 9½-in. focus by a good maker, such as Ross, Dallmeyer, Wray, or Taylor. The components of the lens should be of different foci, so that varying sized plates may be used, or different angles included. A lens of this kind may be made to do duty for a variety of purposes. For example, quoting from one maker's list, a lens of 9½-in. focus covering a whole plate at full aperture (f/6·3) will, when stopped down to f/11·3, cover a 10-in. by 8-in., or to f/22·6 a 12-in. by 10-in. The lens is composed of two compound lenses of 14 in. and 19½ in., covering plates, when used at f/12·5, of 10 in. by 8 in. and 13 in. by 11 in. respectively. The lens is listed at £16 10s. Thus, for architectural work, where a doublet is most needed, the lens might be used in its entirety, and on a 12-in. by 10-in. plate it in a confined situation. When portraits or landscapes where good perspective is an important consideration are attempted, the single components or a smaller plate must be used. It must be borne in mind that the value of the stops varies with the lens. For example, a stop about 1 in. diameter, which, when used with the lens entire, was valued at f/8, would become, approximately, f/22 and f/32 when used with the single lenses. Lancaster's combination rectigraph is on the same principle, and costs £2 10s.

Hollowing the Underside of Ridge Roll.—To hollow the underside of a ledge for covering the joint of a roof as shown in the accompanying sketch (Fig. 1), the end of the piece of wood should be marked out and a small plough groove made, as shown at Fig. 2. The greater part of the superfluous material can then be cut away with a mallet and chisel. The surfaces can be finished with a broad rebate plane or, better still, by a jack plane (or panel plane) with a side slip, which takes off as shown at Figs. 3 and 4.



How to Hollow the Underside of Ridge Roll.

Obtaining Smooth Surface on Glass Balls.—To get a perfectly smooth surface on glass balls direct from the moulds, remove the outer hard skin of glass by revolving the balls with a little fine emery powder and water; after that they will grind themselves smooth. If a polished surface is required, the balls will have to be revolved with plenty of dry rouge, coleothar, putty powder, or other rather soft polishing powder quite free from grit.

Darkening Light Brown Leather Shoes.—To darken a pair of light tan shoes, give them a couple of coats of Propert's dark stain, and afterwards polish with the darkest brown cream that can be obtained. If the leather has not been creamed before, a couple of coats of the darkest brown shade of Dolly dye might be applied: cream takes well afterwards.

Enlarging a Quantity of Small Photographs.—To enlarge to cabinet size, with as little expense as possible, a considerable number of small photographs, stamp size, the prints must be copied the same size, and the negatives thus obtained enlarged upon bromide paper. If the prints are unmounted, proceed as follows:—Soak them in water, and, while they are still in the water, get as many as can be accommodated (probably about sixteen) on to a quarter-plate piece of clean glass that is free from scratches and bubbles, and squeeze well into contact by placing a sheet of blotting-paper over the back and driving out air bubbles. The prints must be placed face downwards on the glass. Put the glass in a printing-frame and hang it flat against a wall in a full light. Extend the camera to twice the focus of the lens and place it at the same distance from the printing-frame, measuring both ways from the stops. Having focussed very accurately in the centre, stop down until the outermost pictures are sharp. Use slow plates and give two exposures, one double the other. These negatives should be enlarged on to bromide paper 24 in. by 18 in., which will give 6 in. to each picture. Pictures as nearly the same as possible in tone should be chosen for enlarging together. Each picture could, of course, be enlarged from a separate negative, but the expenditure of time and money would be considerable. When developing a sheet of this size the developer can be applied with a large pad of cotton-wool or a flat soft brush, first wetting the print with water to slow development.

Height of Domestic Hot-water Expansion Pipe.—The expansion of water in these apparatus never exceeds 1 in 30; that is, the top water line in the apparatus never stands higher than the cold-water line in the cistern which feeds it, more than 1 ft. for each 30 ft. vertical height to which the apparatus extends. It is seldom that an apparatus of this kind exceeds 60 ft. vertical height, and at this height it is seldom that the water is anywhere near boiling point in every part of the apparatus (except the cold supply pipe), as the 1 in 30 rule requires it to be. The common practice, therefore, is to let the expansion pipe extend at least 2 ft. above the cold-water line in houses of moderate size, and 3 ft. or more in tall houses. This is easily remembered, quite safe, and applies to all systems of apparatus. The quantity of water held in the apparatus makes no theoretical difference. In practice, it may mean that the large quantity does not get so hot.

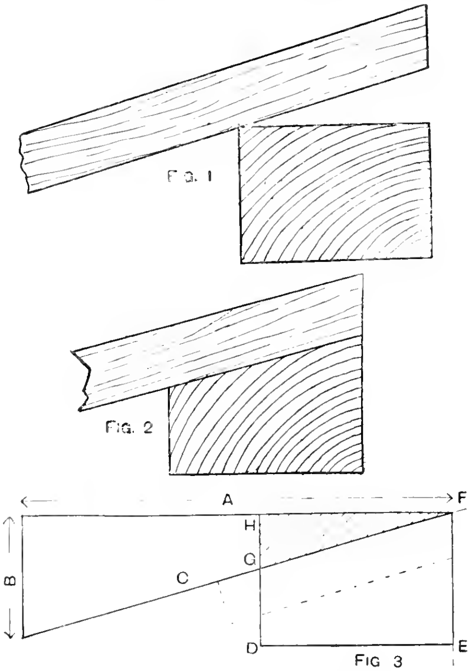
Making Liquid Malt Extract.—To prepare a small quantity of liquid malt extract, cover the malt with water and heat to a temperature of 180° F. for an hour, then press out the extract from the grains. The addition of a small quantity of spirit of wine will prevent it becoming musty. On a large scale, the malt is thoroughly exhausted with sufficient water, and the liquid concentrated in a vacuum pan at a temperature of about 180° F. A steam heat (*i.e.* 212° F.) spoils the malt extract to some extent.

Oiling Watches and Clocks.—In choosing the oil to be used for watches and clocks, it should be remembered that a watch will generally go from two to three years before the oil dries up. A clock, as a rule, will go from three to five years, according to the situation of the clock and the fit of its case. Dried-up oil must always be removed before applying fresh; thus a watch requires cleaning every two or three years. Watches require a very thin light oil, clocks a heavier oil; clock oil would soon stop a watch, and watch oil would soon run away from the pivots of a clock.

Dimensions of Canoe to Carry One Person.—A canvas canoe of the following dimensions would carry one person of ordinary weight on about 4½-in. draught, but by adding 2 ft. to her length she would be considerably easier to propel:—Length over all, 10 ft. 6 in.; length on load water-line, 10 ft.; beam at gunwale, 25 in.; beam on load water-line, 27 in.; draught amidships, 4½ in.; draught at ends, 3½ in.; freeboard amidships, 4 in.; freeboard at ends, 7 in.; the greatest beam being on load water-line, and at a distance of 6 ft. from the bow. Oak, rock elm, pine, or larch will be suitable for the canoe.

Determining Contents of Cylindrical Tank.—First determine the contents of the tank in cubic feet. To do this, square the diameter in feet and multiply by ·7854; then multiply by the length in feet. Thus the contents of a circular tank 7 ft. in diameter by 18 ft. high will be 7 × 7 × ·7854 × 18 = 38·5 × 18 = 693 cub. ft. (approx.). Then 6·23 gal. of water occupy 1 cub. ft., so that the contents of the tank will be about 693 × 6·23 = 4,317 gal. A quicker way is to reckon that a tank 1 ft. in diameter and 1 ft. high will hold 4·9 gal. Then, since the capacity will vary with the square of the diameter and with the length of the tank, it will be about 4·9 × 7 × 7 × 18 = 4,322 gal.

Shaping the Top Rail of Greenhouse.—To determine the bevel or slant of the top cross-bar so that the

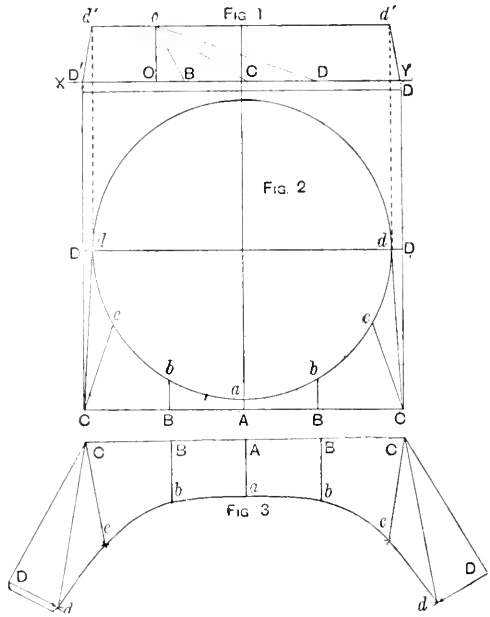


Shaping the Top Rail of Greenhouse.

piece shown in Fig. 1 shall be fitted as in Fig. 2, draw (Fig. 3) to scale as shown. Along a horizontal line mark off the span of the greenhouse to 1 in. to the foot say, as indicated by A; then draw the vertical line shown at B, and mark off the amount of fall (that is the difference between the height of the front and back) to the same scale. Then the line C represents the correct fall. The end view of the rail can now be marked out full size as shown at D E F, and the triangular piece scored shows the amount of material to be taken off. A gauge may be set to the distance G H, and the wood marked by it; or a bevel can be set as indicated by the dotted lines, and the wood planed to suit it in the ordinary manner.

How to Gild Piano Fronts.—Artistic designs similar to work seen on piano panels are usually put on by transfer process after the panels have been bodied up; the subsequent polishing and finishing out will give an appearance of inlaid brass. In exceptional cases the panels are finished out first, the decorative design is carefully cut in with oil gold size, the gold applied, and afterwards outlined and shaded with sienna. Occasionally engraved patterns may be seen, but in the majority of cases only the outlined portions are gilt, the lines being very fine. Piano fronts are often finished with a marqueterie centre, with gold incised borders and corners. To gild these, it is usual to finish polishing the panels before passing on to the gilder, who will brush into the incisions several coats of parchment size and whiting tinted with orange or lemon chrome; this mixture must be spread evenly, as it sets very quickly. Clean off the surplus with a slightly wet rag stretched over a flat cork rubber; avoid rubbing any more in the channels. When a solid basis has been thus formed, oil gold size is applied by means of a very fine hog-hair brush; it is spread evenly. When nearly dry, it is ready for the gold leaf, which is cut up into narrow strips on a special cushion; this is laid over the lines, and well skewed in by a tuft of wadding and camel-hair brush. Clean off all surplus as before, using a piece of cloth slightly damp with turps.

Pattern for Square Aquarium Top.—To make a perforated square zinc top for an aquarium, that could be taken off and put on as required, commence by drawing a plan and elevation (Figs. 1 and 2) to the required size. Divide the semicircle *d d* (Fig. 2) into six equal parts, and draw lines at right angles to C C to pass through the division points *b b*; also join the division point *c* to C and *d* to C. From any point along X Y erect the perpendicular O *o*, and from O mark off lengths corresponding to *b* B, *c* C, C *d* (Fig. 2); join these points to *o*, and the lengths found, B *o*, C *o*, D *o*, will be the true slants of the lines *b* B, *c* C, C *d* (Fig. 2). To work the pattern, draw a straight line equal in length to C C (Fig. 2); mark upon this line a centre point A (Fig. 3),



Pattern for Aquarium Top.

and mark on either side of A divisions corresponding to A B (Fig. 2). From A, B, B (Fig. 3) draw lines at right angles to C C, and mark on these lines from the point A, a length equal to D′ *d′* (Fig. 1), and from B, B lengths equal to *o* B (Fig. 1). Next use C as centre, and with radius C *o* (Fig. 1) draw an arc; with *b c* (Fig. 2) as radius and *b* (Fig. 3) as centre, cut the arc first drawn to obtain the point *c*; again use C as centre on both sides of the pattern, and with radius *o* D (Fig. 1) draw an arc; with the division length *c d* (Fig. 2) cut the arc so as to obtain the point *d*. Now take the length C D (Fig. 2) as radius, and again using C (Fig. 3) as centre, draw an arc; with D′ *d′* (Fig. 1) as radius and *d* on the pattern as centre, cut the arc first drawn. Join the intersecting arcs *d* D by a straight line, and also join D C. Draw a curve through the intersecting arcs *d, c, b, a, b, c, d*, to complete the half pattern with seams placed in the centre of the sides at D *d*, D *d*. When making the top, bend the corners C C upon any sharp-edged tools until the sides form a right angle with the end; the semicircle forming the half top can be brought to shape by pressing the perforation to a circular shape with the thumb. If the two halves are to be grooved together, an equal allowance for the groove will be necessary on each side of the pattern; if soldering is adopted, then one lap, as shown, will do.

Grease for Under-carriage of Victoria.—The best lubricant to use on the perch bolt and felloe pieces when putting together the under-carriage of a victoria is made by melting some tallow, then mixing with it sufficient axle oil so that it will be quite soft when cold, and about two small packets of powdered blacklead to 1 lb. of tallow and oil. The under-carriage, if the vehicle is in constant use, should be taken out each time the trap is oiled, which is about every three months.

Removing Brass Collars from Glass Ware.—If it is wished to preserve the collars, allow them to stand for some time in dilute hydrochloric acid, which will dissolve out the plaster-of-Paris. If the collars are not required, place them in strong nitric acid, which will dissolve the brass. Another method is to make file marks just above the collars, heat a piece of glass rod or thick iron wire in the blowpipe flame, and place it on the file marks. Often a crack will go right round at once; if not, the crack can usually be obtained after two or three heatings in this way.

Tightening up Floor Boards without Using a "Dog."—Floor boards can be tightened up without the aid of a floor dog by the method shown at Fig. 1. The board next the wall should be well secured to the joists, and then three or four boards can be laid down and tightened up by means of wedges, as shown. The following is the method of procedure:—Place a piece

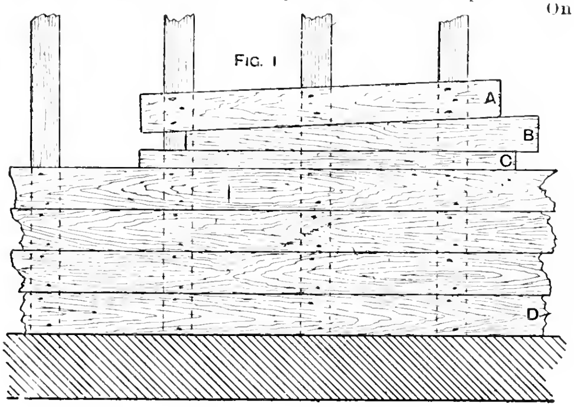


FIG. 2

Tightening-up Floor Boards.

of quartering about 2 in. by 3 in. next to the floor board, as at C. Cut a wedge, and place it as at B; then nail down a piece of batten to the joists, as at A (both this and the wedge can be cut out of odd pieces of floor board). The wedge B should be driven with a large hammer or axe until the joints of the board are quite close. Use prepared grooved and tongued boards, a section of which is shown at Fig. 2, to prevent dust and draught passing through the joints of the boards after they have shrunk.

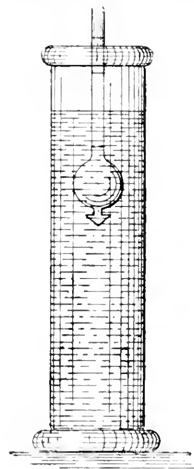
Transferring Drawings to Linen.—Transfer drawings of flowers, etc., are made with some composition on tissue or tracing paper from stencil plates cut to suit the particular patterns. The composition is a material consisting of resin and colouring matter (common red sealing wax would do). This is powdered and sprinkled over the stencil while it is lying on the paper. On running a hot iron over the stencil plate the design is left on the paper. To transfer to linen, place the paper on the linen and run a hot iron over the back of the paper.

Blackening Brass Buttons.—To make shiny brass buttons black, immerse them in a strong solution of copper nitrate or sulphate. Then heat them on a hot plate or carefully in the flame of a Bunsen burner till they are black. Well swill them in hot water, and dry out in sawdust; polish with a blacklead brush and lacquer.

Bevelling Plate Glass.—To obtain a bevel edge on plate glass, either circular revolving tables or fixed ones may be used. The table for grinding is of thick cast iron, and is fed with sand and water; the smoothing table is of glass with emery of different degrees of fineness and water, and the polishing tables are of wood covered with leather or felt and sprinkled with rouge of increasing degrees of fineness. If revolving tables are used, the glass plate must be fixed in a frame capable of being adjusted at any required angle, and the frame must be brought down until the edge of the glass just touches the table. As the grinding proceeds, the glass is brought lower until the bevel is fully formed. After bevelling all the edges the glass must be transferred to the smoothing table, and finally polished on the wood table. If fixed tables are used, the frame containing the glass plate will have to travel perfectly true backwards and forwards over the tables.

Taking Apart a Geneva Lever Watch.—In taking a Geneva lever watch apart, first remove it from its case; then lever off the hands, remove the dial, and take off the motion wheels underneath it. Next remove the central set-hand arbor by knocking it out with a light tap. It is friction-tight only in both the cannon pinion and the centre wheel. Then let down the mainspring by a key on the winding square while holding the click back. Take out the balance, pallets, 'scape wheel, train wheels, centre wheel, and barrel in the order named.

Particulars of Salinometers.—There are two kinds, one giving the percentage of common salt in the solution, the other used by marine engineers as a guide to the point at which to blow off. Salinometers are made either of glass or brass in the form shown in the adjoining figure. On the first kind each mark represents 1 per cent. of



Salinometer.

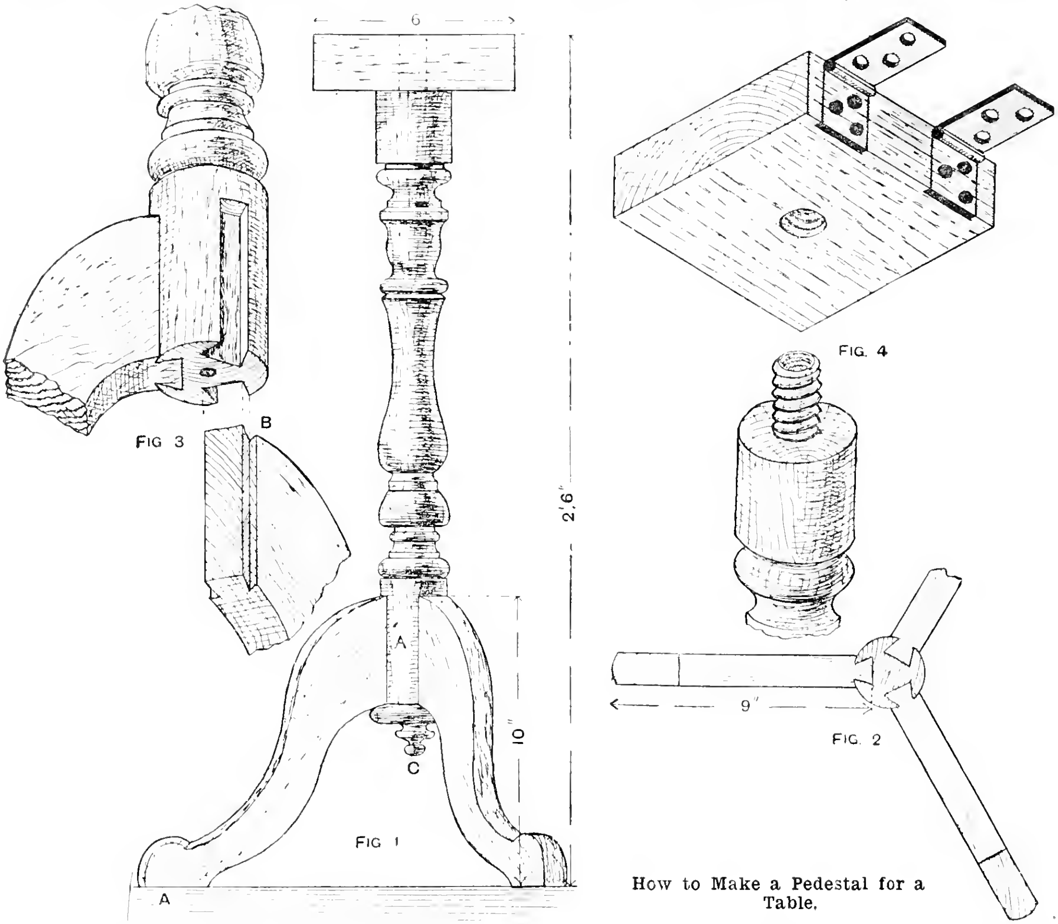
common salt; on the second kind there are only three or four marks, one being marked "blow." To use the instrument, float the salinometer in a little of the water; the mark on the stem corresponding with the surface of the water indicates the density of the liquid.

Mixing Lime Concrete.—For ordinary foundations, with no great or concentrated loads, the following proportions may be adopted: Bricks, broken to pass through a 2-in. ring, $1\frac{1}{2}$ parts; clean, sharp sand, $2\frac{1}{2}$ parts; ground lias lime, 1 part. If the bricks are broken to pass through a $1\frac{1}{2}$-in. ring, then 5 parts to 2 parts sand and 1 part lime may be used. The materials should be accurately measured in gauge boxes, turned over twice or thrice, dry, so as to be intimately mixed before being wetted, water applied by means of a watering can with a rose on the spout, materials again turned over twice, deposited in the required spot in layers about 12 in. thick, carefully rammed, and left to set. It is important not to disturb the mass after it has begun to set.

Cleaning Velvet-pile Table Cover.—To clean a velvet-pile table cover, first remove all dust by hanging up the table cover and carefully beating it; then treat it several times with benzine, pressing each time so as to remove all the dirty liquid; then hang it in the open air to dry. Of course, this dry cleaning should be done in a room in which there is neither fire nor artificial light. After thoroughly drying, if the table cover is not sufficiently clean, lay it on a table and carefully sponge it all over with a mixture of equal quantities of methylated spirit and water. Do not wet it more than is absolutely necessary, and immediately dry it by pressing dry, clean linen cloths upon it. Again dry the cover, and brush it carefully with a moderately stiff brush to raise the pile.

Heat-resisting Covering for Steam Boilers.—Hair, cotton, fibres of organic origin, and feathers are the best materials, though fine sawdust and cork powder have been used. Clay with fibres, and fibres with cow-dung have also been employed. The materials should first be powdered, and afterwards applied in the form of washes to the surface, which must be quite free from grease. A covering of canvas, wire netting, hoop iron, boards, etc., should be placed outside.

Making a Pedestal for a Table.—The following illustrations give a design for a pedestal for a walnut table top; the table is 2 ft. diameter and ½ in. thick. Fig. 1 shows the elevation and Fig. 2 the greater part of the plan, looking up. The column should be turned out of stuff about 3 in. square. The upper part of the column can be finished with a screw, as shown at Fig. 1, for fastening on the block. The legs should be cut out of material with the grain running in the direction of A A (Fig. 1). A simple method of connecting the legs to the column is by means of dovetail housing, shown at Fig. 2. A conventional view of this joint is shown at Fig. 3. It should be noticed that the shoulders require to be undercut (see B, Fig. 3). The "drop" shown at C (Fig. 1) is a separate piece of turning with a dowel attached so that it can be fastened to the bottom of the column. The top may be hinged to the block by means of two flaps, as indicated at Fig. 4.



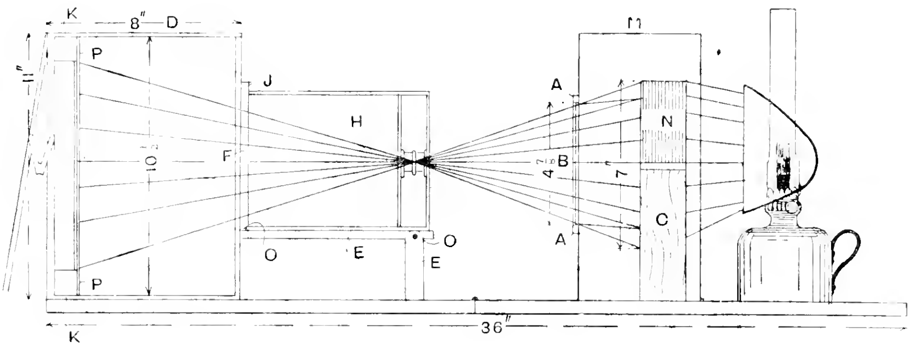
How to Make a Pedestal for a Table.

Method of Burning Limestone.—No very great improvements in the method of burning mountain limestone have been made for several years, but there are kilns, such as the Hofmann kiln, and calciners which are great improvements on the old forms of kiln. The Hofmann kilns are very large and circular or oval surrounding a chimney stack: they can be divided into twelve or more compartments, each one of which has a door for charging purposes, an opening connecting it with the chimney and covered with a damper, and holes in the roof for stoking purposes. In starting the kiln all the compartments but one are filled with limestone loosely piled and the doors made up. Fires are made in the empty compartment, and the dampers are all closed with the exception of that in the farthest chamber, so that the flames and hot air have to travel all round the kiln before they escape to the chimney. As the coal burns away slack is fed through the holes in the roof, and when the limestone is fully burnt in the first compartment the damper in the empty compartment is thrown open and the other closed, so that the empty compartment becomes the last in the series, and the first compartment begins to cool down. The coal is now fed through the roof of the second compartment, and this procedure goes on right round the kiln. The empty compartment is charged as soon as it is cool enough to enter: the first compartment is next emptied and refilled, and so on, emptying and refilling going on all the time. The calciner is made in the usual form of circular kiln, but it has a cone-shaped structure at the bottom, and there are openings all round the circumference of the furnace above the floor level. The limestone and slack are fed in at the top, and as the coal burns away and the limestone contracts during its conversion into lime, it gradually descends, but is prevented settling at the bottom of the furnace by the cone-shaped structure, which directs the material towards the walls of the furnace, and it falls out through the openings above mentioned.

How to Get Rid of Mites in Furniture.—Use ordinary furniture polish on the wood of the furniture, and place a saucer full of strong ammonia below the sofa and chairs from time to time. As a rule, a dry room is best for furniture, and therefore a fire should be lighted often. It will prevent the damp settling upon the furniture and carpets, and will tend to keep out insects. Washing the floors with a carbolic soap will also be found of great value.

Varnishing a Van in the Natural Wood.—Where the grain is to show out plain it is not customary to stain the wood: staining blurs the natural grain, on account of one part absorbing more stain than another. The method usually adopted for vans, etc., is as follows: After the body is got up clean, and glass-paper marks across the panels have been removed, apply a good coat of pale gold size, to which about a tablespoonful of linseed oil to a pint of size has been added; let this stand a day or two, then lightly rub over with fine sand or glasspaper to take off the grain which will rise; then give another coat of gold size only. When hard, sandpaper off as before, and apply a coat of hard drying carriage varnish. Let this stand for a couple of days, and then flat down with ground pumice-stone and water, being careful to wash every particle of dust from the corners; then give a coat (or two coats if necessary) of best carriage varnish.

Enlarging with Fixed Focus Hand Camera.—The accompanying sketch shows an arrangement for making either enlarged negatives or prints. In the bottom of a lidless box M cut an opening 1⅞ in. by 3⅞ in.; fit grooves A A top and bottom, to carry the negative B (the box is standing on end). Make a box D of the size and shape shown (see also ground plan), having an opening at F a little smaller than the hand camera H, and with a close-fitting fillet run round it on the outer side at J, forming a recess, into which the back of the camera fits, and is supported on the bracket E. The bracket is either detachable or hinged at O O. At the rear of the box is fastened another fillet P, at exactly 13 in. from the lens stops. Cut a slot right down one side rather greater in width than the thickness of a whole-plate printing frame. The frame should now be built up at the same side flush with the outside of the box, and a further piece screwed on, projecting ¾ in. each way beyond the opening, and fitting close to exclude light. Now insert the frame, facing the lens, and screw another fillet behind it, so that it just runs easily between them. The frame is assumed to measure 10½ in. by 8½ in. Next cut from a block of wood C a recess to form a bed for the condenser N, the centre of which must be exactly opposite the centre of the negative, the lens, and the printing frame. A lid may be hinged to D. The camera and other loose parts may then be stored inside. Now construct a board 36 in. by 8 in., hinged in the centre. Put two screws in the extreme end; these, by engaging with holes in D, ensure its being always in the same place. Now place the other parts roughly in position. Fix, with drawing-pins at the corners, the sheet of ground glass, rough side outwards, in the printing frame, and insert it in D. Having put the negative B in position, focus very accurately by moving the box to and fro. The condenser and light are next manipulated until the corners of the negative are illuminated and an evenly lighted screen is obtained. Then screw the block in position in M, and fit the points for the other parts as before. Instead of using a condenser, a piece of magnesium wire may be burnt behind the negative, the light being waved about, so that the negative may be evenly illuminated. In this case a sheet of ground glass should be placed a few inches behind the negative. To use the apparatus it will merely be necessary to insert the negative, then place in the printing frame a sheet of clear glass, free from bubbles or scratches, and of the same thickness as the ground glass mentioned above. Place upon this, face downwards or outwards, a sheet of bromide paper, and, having turned the light down very low, insert through K. If preferred, a sheet of cardboard, which can be slid out after placing the frame in position, may be made to run in front of the printing frame. The above dimensions are worked out on the assumption that the lens is of 5-in. focus.



Enlarging with Fixed Focus Hand Camera.

Using Gold Bronze.—To apply gold bronze to furniture in paint form, coat the furniture with paint, japan, spirit varnish, or anything that will prevent suction; then coat where the bronze is wanted with gold size or quick-drying varnish. When this is nearly dry, dust on the powder with a camel-hair brush or soft new chamois leather. As bronze is susceptible to atmospheric influences, it should be coated with a thin, even coat of varnish—clear spirit or oil varnish will do. Work thus treated will have a common brassy appearance, by no means equal to gilding. When gold leaf is too expensive, use Dutch metal, which can be purchased at from 2d. to 6d. per book.

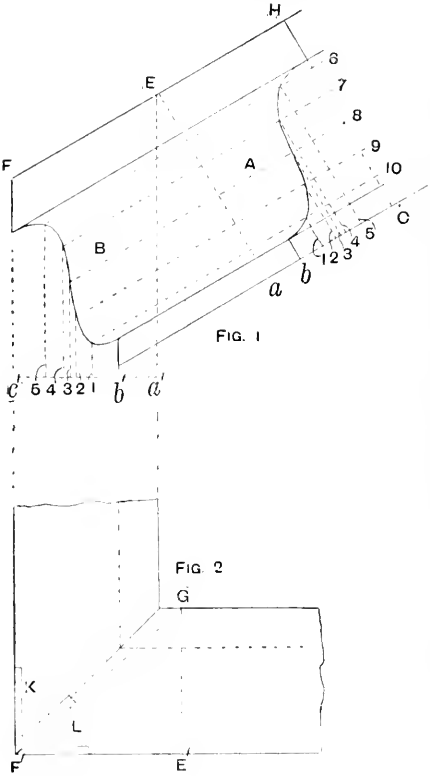
Utilising Old Vulcanised Indiarubber.—The tools required would be a small rotary cutter, a sheet-iron box with sliding front and chimney at top, an iron tray, two large ring gas burners, knives or spatulas, and iron moulds shaped like the blocks required. The rubber may be cut in the rotary machine, mixed with powdered sulphur, placed on the iron tray in the sheet-iron box, and heated by the burners. A thermometer hung in the box very close to the iron tray will show the temperature, which must not rise above 300 F. When the rubber is softened, the moulds may be heated in the box, the rubber put in, and the tops of the moulds forced down so as to compress the rubber; the moulds may then be allowed to become cold, and the blocks withdrawn. Before pressing in the rubber, rub powdered French chalk over the insides of the moulds.

Obliterating an Engraved Crest on a Silver Jug.—To remove an engraved crest from a small silver jug, (1) file out the work with a fine flat file if the surface of the jug is of a full or rounded nature, and with a rifller or small bent file if hollow. Finish with snakestone or Tam-o'-Shanter hone, and polish with rottenstone and oil. Send it to be electro-gilded and scratch-brushed on the inside, with a light coating of silver on the outside, and have the outside burnished and "handed up." The jug will thus look equal to new. Before sending to plate, look well over for possible dents. (2) Fill up the cuts with silver solder—same colour as near as possible to the silver—dress off, and finish as No. 1. (3) Cut out a shield from sheet silver (No. 6 to 9 gauge, S.M.G.) either round, oval, or of an heraldic shape, hard solder neatly, and finish as No. 1.

Shaping Soap into Bars and Tablets.—The soap is made by boiling fats and caustic soda in large pans, from which it is run through channels over the "frames": the latter are large rectangular moulds built up of iron plates bolted together. When the soap is cold the plates are unbolted and removed, revealing the blocks of soap. A frame with horizontal wires is run through the blocks, cutting them into slabs. The slabs are pushed against other wires, cutting them into bars. Tablet soaps are pressed from the bars or from ribbons. Toilet soaps are made by forcing bar soap against a cutter, which cuts it into thin slices; the slices are placed in a roller machine, from which it emerges in the form of extremely fine shavings. The shavings are partly dried on wire netting in a heated room and then placed in a press, from which the soap emerges as a bar with a square, round, oval, or other section. The bar is cut into pieces of equal thickness forming plain tablets, which are then pressed in a machine having dies with appropriate designs. In scented soaps the ribbons are gently heated with the scent, or the scent is added immediately after the soap is made for common qualities.

Calculating Heating Surface of Radiators.—For calculating the heating surfaces of radiators and pipes for schools, greenhouses, etc., the following notes are useful:—For brick buildings, for a temperature of 50° F., use 7 sq. ft. of heating surface for every 1,000 cub. ft. of space; for 55° F., use 9 sq. ft.; for 60° F., use 12 sq. ft.; for 65° F., use 15 sq. ft.; for 70° F., use 19 sq. ft. For lean-to glasshouses, for a temperature of 45° F., use 37 ft. of 4-in. pipe for every 1,000 cub. ft. of space; for 50° F., use 40 ft. of 4-in. pipe; for 55° F., use 45 ft. of 4-in. pipe; for 60° F., use 50 ft. of 4-in. pipe; for 65° F., use 55 ft. of 4-in. pipe; and for 70° F., use 60 ft. of 4-in. pipe. For span houses, add one-fifth.

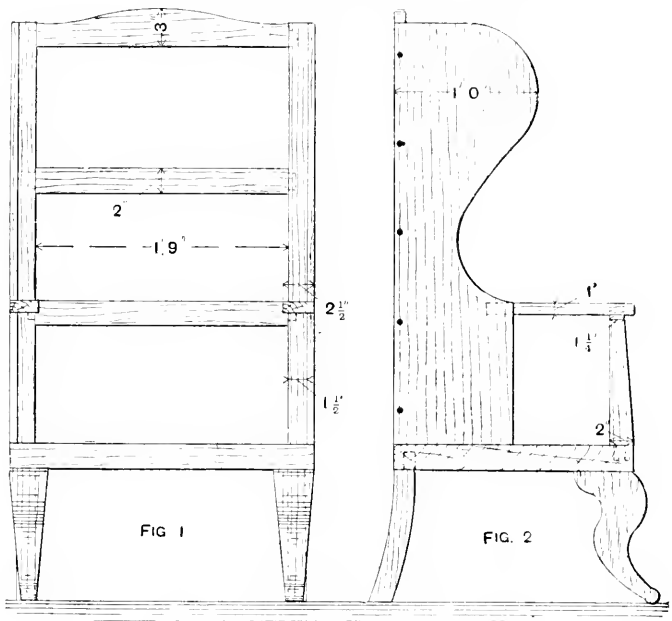
How to Find the Mitre, etc., of Raking Cornice Moulding.—A (Fig. 1) shows the true section of the raking moulding. The five points have been taken in the curve, and lines 6, 7, 8, 9, and 10 drawn through them. Then from these points perpendiculars are drawn to the bottom line—Nos. 1, 2, 3, 4, and 5; also C. From E draw the vertical line a' E, and at right angles to it $a'c'$. Now mark off the divisions a', b', 1, 2, 3, 4, 5, and c' as shown, making them correspond to a, b, etc. Next raise ordinates, making them intersect their respective raking line as shown. Through these points draw the curve, and complete the section of the level moulding. To obtain the mitre, project the plan as shown at Fig. 2; then take the distance E F (Fig. 1) and mark it off on the plan as shown at E' F'; project across to G, and join F' to G. Then the bevel for the mitre of the raking mould will be that shown at L, and that at K for the bevel mould.



How to find the Mitre, etc., of Raking Cornice Moulding.

Clock Escapements and Motive Power.—When a cheap clock, such as an American spring clock without a fusee, is first wound up, the motive power is very great, and when the same clock is nearly run down, the power has diminished to perhaps less than half. The effect of this with a recoil escapement (one in which the 'scape-wheel recoils at each beat) and a light pendulum is to make the clock go gradually slower as it runs down. With a heavy pendulum the error is less. A dead-beat escapement (one in which the 'scape-wheel remains perfectly still between each beat) has a very small error in the opposite direction, and the same clock fitted with it would gradually gain as it ran down. Therefore, to keep correct time, the escapement must not have much recoil, nor must it be perfectly "dead." A cheap clock with a light pendulum should have an escapement with a moderate recoil only, and a good clock with a heavy pendulum should have a nearly dead-beat escapement, or what is known as a "half dead," *i.e.* a dead-beat with a very slight amount of recoil on the resting surfaces, but hardly perceptible. The amount of recoil is determined by the shape of the pallets.

Making Marlboro' Easy Chair.—Figs. 1 and 2 show front and side views respectively of the framing. The total height is 4 ft.; width, 2 ft.; height of seat without cushion, 1 ft. 1 in.; height of arms from seat, 1 ft.; and width of seat from front to back, 1 ft. 8 in. The back legs, with the required sweep at the bottom, can be bought ready sawn at any chairmaker's. The seat frame is made from 2-in. by $1\frac{1}{2}$-in. stuff; the rest of the frame from 1-in. stuff, with the exception of the front legs, which can be made Chippendale shape, square tapered, or turned in the lathe. Web the seat, back, and arm space for foundation for stuffing.



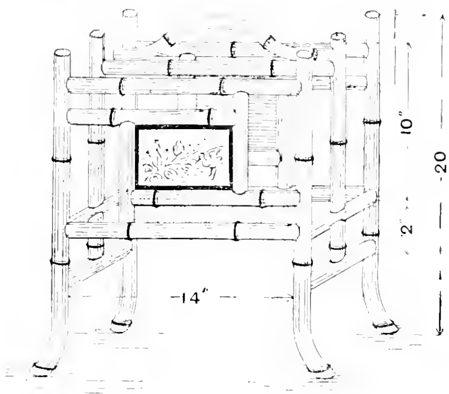
Marlboro' Easy Chair.

Make a loose cushion seat. Upholster in coarse canvas with hair or flocks, nailing the material on the outside edges; then cover with Gobelin tapestry or cretonne; cover the sides and back with the same material, sewn together at the edges and corded, or tack round a narrow coloured gimp.

Colouring Drawings.—The colours used in architectural and mechanical drawings vary according to circumstances. Some draughtsmen use a very pale sepia for York stone in elevation, pale Payne's grey for Portland or Bath stone, pale indigo with ink dots for granite, and darker tints of the same colours for the sections. This, it must be remembered, is chiefly in connection with London stock bricks. Architects, who ought as a body to have an eye for colour, are sometimes great offenders by using harsh and unnecessary colours on their drawings. An extreme case has been noted where a wrought-iron girder resting upon a cast-iron column standing on a stone base were all coloured bright Prussian blue. Blue in some form or other is much used by architects to represent stone, but it should be used very sparingly, so as to resemble the natural tint of the stone rather than the conventional representation. For a red sandstone, a pale tint of light red, Indian red, Venetian red, or burnt ochre might be used, depending upon the general elevation colour. For cement in any form in elevations, pale Indian ink or pale Payne's grey is generally used, with or without dots and markings. Windows may be coloured with black Indian ink, or washed Prussian blue, Prussian green, or Payne's grey, according to circumstances. A plain tint all over is the simplest, but a good artistic effect may be obtained with the exercise of a little skill.

Oleomargarine.—This is the softer portion of the purest and freshest beef suet from the ribs, rendered at 140° F. to 170° F., and the fat poured off clean and pressed at 95° F. The product is of a buttery consistency at ordinary temperature. The "oleo" oil, as it is called, is the chief constituent in margarine, but a vegetable oil is also employed; sometimes this is cottonseed oil, at others earth nut oil or sesame oil. The oleo oil is melted and, along with the vegetable oil, is run into the churns; the milk is first soured by the addition of acid, rennet, or sour milk, run over cooling coils, and then into the churn. The churns are kept slightly warm, and are worked so that the fat, casein, etc., may amalgamate. They are then emptied into tanks containing water cooled with ice, the masses of fat are removed, piled up to drain for some time, then worked and salted like butter.

Bamboo Newspaper Rack.—Four 1-in. and two $\frac{5}{8}$-in. canes will be required; from the former four lengths should be bent or toed out and cut off 20 in. long. Four pieces, each 16 in. long, for the four rails should now be cut off from the 1-in. canes, chisel-pointed, mortised (or hollowed) with the rasp, and fitted in their places. Holes should then be bored in the legs to receive the dowels, and the two sides framed up. While these sides, or sections, are setting, the two ornamental fillings should be made from $\frac{5}{8}$-in. cane.

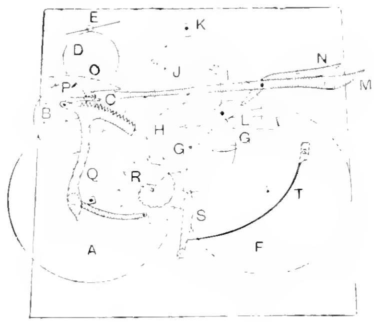


Bamboo Newspaper Rack.

Four pieces of 1-in. bamboo, each 9 in. long ($1\frac{1}{4}$ in. is allowed for fitting), should now be prepared to form the cross rails which are to join the two sections together. When the sections are set, holes should be bored to receive the dowels of the cross rails, and the whole joined together. The two uprights for the partition are fitted to the bottom cross rail, and the top cross rail and upright are half jointed where they cross. The rail which carries the handle is mortised and dowelled at each end and fastened into position with two round-headed screws. The handle is made from $\frac{5}{8}$-in. cane bent as shown, and fastened to the centre rail with round-headed screws. The rails which form the division of the partition, as also the three cross rails forming the bottom, are made from $\frac{5}{8}$-in. cane mortised at the ends and fixed into position with beading pins. A diagonal stay, not shown in the illustration, may be added to the central framework.

Photographing an Oil Painting.—Whether the painting is under glass or not, it will probably be advisable to let it face the window. All reflections must be got rid of; sometimes slightly tilting the picture and swinging the back of the camera to compensate for it will be effectual. If possible, the centre of the lens should be opposite the centre of the painting. If the illumination in the camera is weak, focus upon finely grained glass, made by thickly coating a sheet of glass with negative varnish, and then rubbing down the surface with a little finely powdered resin on the ball of the finger; or the ordinary ground glass screen may be oiled. A firmly fixed copying camera, in which focussing is done by moving the back part, would be preferable to an ordinary camera. The lens should be one giving a flat field and the best possible definition. The stand must be rigid, and, as the exposure is prolonged, every precaution must be taken against vibration. The plates used must be colour-sensitive; Edwards' instantaneous isochromatic are very suitable. If the picture contains any blues or greens, a yellow screen must be used—a home-made substitute for which can be made by staining to a lemon yellow a fixed unexposed plate in a weak solution of picric acid. If the stain is too deep, the blues and greens will be rendered too dark. Pyro soda is a most satisfactory developer for the above-named plates. Use equal parts of each of the following solutions: No. 1. Pyro, 25 gr.; sodium sulphite, ½ oz.; water, 5 oz. No. 2. Washing soda, 165 gr.; water, 5 oz. Add one drop per oz. of 10 per cent. potassium bromide solution. The negative should be thin and full of detail, with clear shadows.

Vienna Regulator Striking Clock.—In the accompanying figure the wheels between the plates are represented by plain circles to show their positions. The gut lines are wound up on barrels, fitted with winding ratchets and clicks and click springs to prevent running back. The main wheels are driven by the barrels, and are mounted upon the barrel arbors. Around the pin wheel are arranged the lifting pins, which lift the gong hammer. The pallet wheel arbor carries the gathering pallet, which gathers up the rack teeth during striking. The snail, mounted upon the star wheel, determines the number of blows to be struck at each hour. This system of wheels is known as the rack striking work, and is used in a great many French clocks and in nearly all English grandfather and bracket clocks. The letter references are as follows:—A is the striking main wheel, B pin wheel, C pallet wheel, D warning wheel, E fly, F going main wheel, G minute wheels, H centre wheel, I third wheel, J 'scape wheel, K pallets, L minute wheel cock, M warning lever, N lifting



Vienna Regulator Striking Movement.

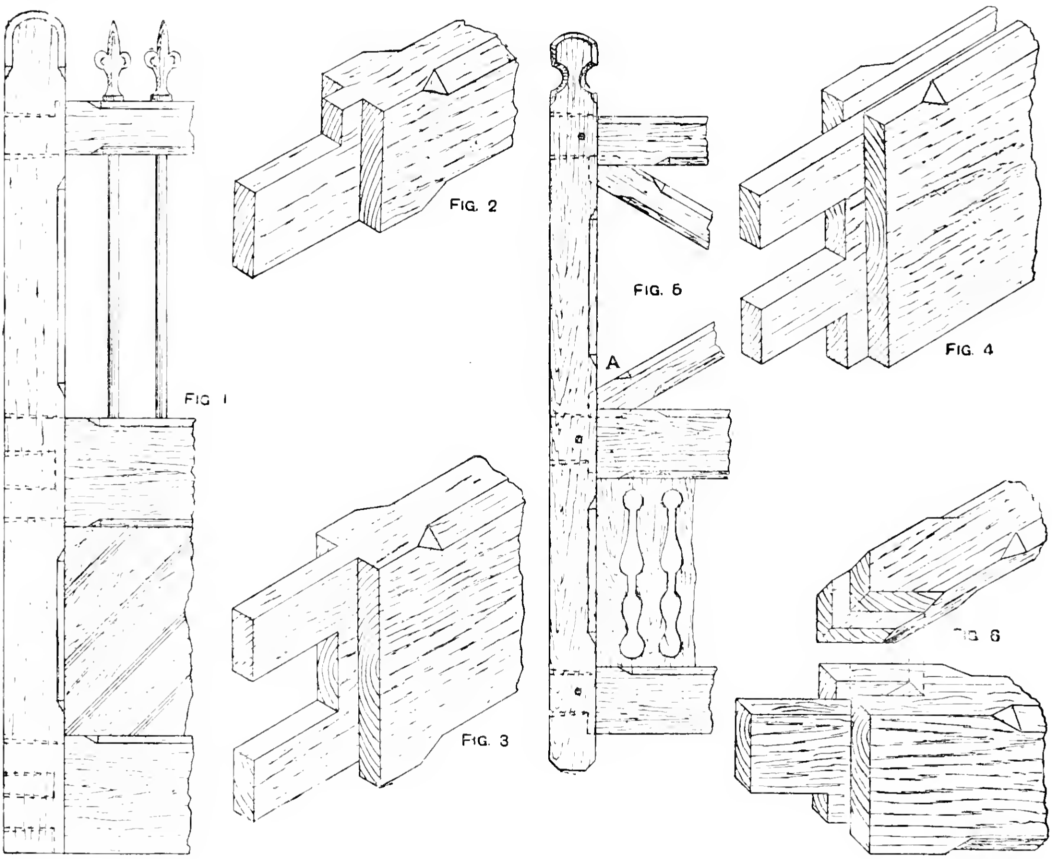
piece of warning lever, O rack hook, P gathering pallet, Q rack, R star wheel and snail, S flirt, and T the flirt spring.

How to Make Crystoleum Photographs.—A portrait should be chosen giving good gradation without very deep blacks. A pair of concave glasses in different sizes may be bought of any artists' colourman, and should be chosen to fit the picture. Mix some starch—as for ordinary mounting—to the consistency of thick treacle, free from lumps, and, having carefully cleaned the glasses and soaked the print and blotted off the surface moisture whilst lying face up on a sheet of glass, brush the starch well over the face of the print and over the concave side of the glass. Bring the two surfaces into contact and lay over the picture a thin sheet of blotting-paper; place the glass on a cushion and work the print thoroughly into contact with the glass by stroking with the convex side of a spoon in all directions from the centre until all air bubbles are expelled. When the print thus mounted is thoroughly dry, it is rendered as transparent as possible by rubbing away the paper, quite evenly, with fine glasspaper. When the film is nearly reached, cuttlefish powder may be applied with the finger or a tuft of wool. The print is next warmed carefully and rubbed over evenly with castor oil till it will take up no more, the surplus oil being wiped off and the print allowed to cool. Transparent oil colours are next laid on over the dress, hair, eyes, lips, etc. Flat tints merely are used, as the transparency supplies the modelling. The second glass is then attached, and on it the flesh tints are painted. The outlines must in all cases be carefully followed. The crystoleum may now be bound up by placing a piece of white cardboard at the back and binding the edges with black paper.

Stain and Varnish for Elm.—For indoor work, use a good quality spirit varnish; for outdoor work, use a good oak, copal, or carriage varnish. A wipe over with raw linseed oil will fetch out the figure, a reddish tinge being imparted by colouring the oil by adding a small quantity of alkanet root—2 oz. to 1 pt. Elm is a good wood for taking a walnut stain. Use a grain filler before applying any varnish or polish.

Two Boilers to One Hot-water Cylinder.—When a cylinder system apparatus is to be heated by two boilers, one boiler is generally connected to the cylinder in the usual way, and the pipes from the second boiler connected to the pipes of the first one, flow to flow and return to return. No fault can be found with this arrangement, which works well, whether either boiler is used separately or both are used together, and no stopcocks are needed. However, a better arrangement is to connect the pipes from each boiler into the cylinder independently, instead of allowing the pipes to join outside the cylinder. In this case there is the possibility of more uniform results, and it seems a more correct way to do the work, although no fault can be found with the plan first explained.

Construction of Tenons for Entrance Gates.—The construction of tenons for gates, such as entrance gates to parks or lodges, is shown by portions of two typical examples of gates (Figs. 1 and 5). The forms of the tenons, etc., are indicated by dotted lines. Figs. 2, 3, and 4 show isometric views to a larger scale of the tenons indicated at Fig. 1. Fig. 6 is an oblique projection of the joints at A (Fig. 5). When the rails are 3½ in. and under, they usually have tenons the whole width; but when over 3½ in. and up to 6 in. the tenons are diminished generally to 3 in. or 3½ in., having a haunch on one or both sides. When the rails are more than 6 in. wide, they frequently have two tenons in breadth as illustrated. The tenons are wedged into the mortises (see Figs. 1 and 5), and as an additional security they are occasionally pinned as indicated at Fig. 5.



Construction of Tenons for Entrance Gates.

How to Test Gold.—File a clean spot upon the metal to be tested, so that any gilding or outside colouring may be removed. Apply a small drop of pure nitric acid to this spot, and watch it closely. If the metal is brass, it will boil up a bright green immediately. If an imitation gold alloy, it may go black in a few seconds. If 9-ct. gold, it will turn a pale brown tint. If 15-ct. or over, it will remain unaltered, and the acid will stand upon it like water. Now press the tip of one finger hard upon it and wipe the finger again immediately. If 15-ct., the spot will turn a pale brown, as 9-ct. did before pressing with the finger. If 18-ct. or over, the acid will still stand upon it like water; 22-ct. can be told by its colour by an expert.

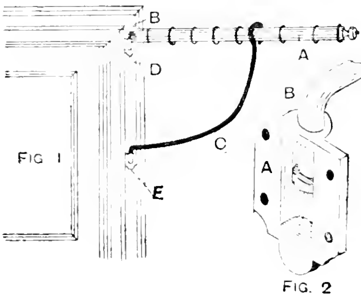
Dry-cleaning a Valencia Waistcoat. — Sprinkle a mixture of fuller's earth and magnesia over the waistcoat, then rub it in with a clean piece of flannel. With another piece of flannel apply benzine to the waistcoat, after which sprinkle some more of the powder and leave it for several minutes. Then brush off the powder and hang the waistcoat in a current of fresh air till the benzine has evaporated.

Staining White Wood Teak Colour.—Brush over the article some raw sienna ground in water, mixed in stale beer, and allow it to soak in. When nearly dry, wipe off the surplus with clean rag; this will give a yellowish undercoat. Now take some Vandyke brown ground in water, mix as before, and apply with a ragged piece of sponge, putting in the figure and varying by a tremulous motion of the hand, blending the colours and removing any harshness by going over the still moist colours with a badger softener or a clean soft sash tool. When quite dry, rub smooth with coarse rag or fine glasspaper, wipe over with raw linseed oil, then French polish or spirit varnish. A slight tinge of red in the polish will be an improvement.

Producing Crystals upon Wickerwork.—To produce crystals upon wickerwork, such as baskets, boil about 2 lb. of alum in 1 gal. of water, and, while still hot, pour this into a jar large enough to hold the baskets. When cool, some of the alum will crystallise out, leaving a saturated solution. Hang the basket in this solution, tying a string to the bottom and attaching a weight, so that the basket is suspended in the centre of the liquid. If allowed to remain several days, the basket will become covered with crystals, which will continue to grow in size if the jar be freely exposed to air.

Gilding Glass.—For gilding on glass, isinglass and distilled water are used; sometimes a little pure spirit of wine is added, but not necessarily, as the best results can be obtained with the distilled water and isinglass alone; these must be boiled for about five minutes and then passed through a filter or white blotting paper. Three grains of the best isinglass to 6 fluid oz. of distilled water make a good gilding strength. The liquid is then, by means of a broad camel-hair brush, floated upon the glass, which must be placed in a slanting position. While still wet the gold is laid on from a gilder's tip and cushion, and after it has been allowed to dry it is gently rubbed with a piece of fine wadding and the cracks or joints touched up. A second application of the gold leaf gives more solidity and makes a better job. It is now burnished again with the wadding and bathed with lukewarm water to bring up the burnish, drying with blotting paper. When thoroughly dry, burnish again, and then with a size brush dipped in water, with the heat increased each time, go over the gold again, thus giving it a third bath. It is then again rubbed and finally coated on the back with gilding size, which, when dry, is rubbed with the cotton. It is then ready for cutting into shape, which is done with a strip of wood cut like a chisel. When the letters have been cut they may be backed with japan gold size or ordinary black japan, or a mixture of the two. For small ornaments such as corners, paint directly on the gold with the japan, and when thoroughly dry, rub off the superfluous gold to leave the gold figures on the glass.

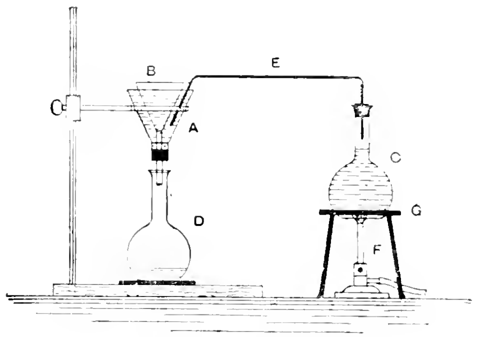
How to Make a Portière Rod.—The rod A (Fig. 1) is cut from a broomstick; at one end is fixed a fancy wood knob, at the other end a piece of brass pipe to act as a ferrule; into this end is screwed a round-headed brass screw bent to the shape shown (B, Figs. 1 and 2). Before screwing this into the end of the rod, it is fitted into a brass socket (see A, Fig. 2) originally made for door bolts to shoot in. The bracket C (Fig. 1) is made from ¼-in. iron and bent round the rod as shown, with one end fitted into a similar socket to that in which the rod fits. Brass curtain rings are put on the rod before it is fixed up. To fix it up, the sockets D and E (Fig. 1) are screwed to the door jamb. The rod is fixed inside the room, and when hung with drapery it serves to prevent a draught blowing on to anyone sitting at the right-hand of door when the door is open. The rod could be made of bamboo and with screw-eyes in place of sockets.



How to Make a Portière Rod.

Polishing Marble.—Marble, such as is used for mantelpiece jambs, is polished in a variety of ways, the choice depending largely upon the nature and quality of the material, which vary greatly. The following method will answer satisfactorily for vein, statuary, Sicilian, St. Anne's, Bardilla, and most of the ordinary coloured marbles in general use. The wrought surface is rubbed with fine sharp sand and water, until all the marks of chisel or saw are removed and an even surface is produced. It is then "grounded"—that is, rubbed with grit stones of varying degrees of fineness, commencing with the coarse or first grit, usually Robinhood stone; next the second grit, which is a little finer; finishing with snake stone or Water of Ayr stone. Particular care must be taken that in each process of gritting the marks or scratches of the preceding one are removed, so that when the surface is snaked no scratches whatever are visible. The gloss or natural polish is obtained by rubbing with a pad of felt sprinkled with putty powder (calcined tin) moistened with water. The chief factor in this method is persistent and attentive rubbing, and a good polish thus obtained will retain its lustre for years. For speed and cheapness chemicals are sometimes used for polishing, such as oxalic acid, hydrochloric acid (spirit of salts), and others, but their use is to be deprecated, as the polish soon vanishes and the face of the marble is in some measure destroyed. The polishing of marble adds greatly to its beauty, inasmuch as its delicate figuring and gradations of rich colouring are brought out and heightened as it were by the process, which gives marble its value as a decorative material. With regard to the appliances, for mouldings the grits are cut into small strips and shaped into hollows and rounds to fit the various members; and for the polishing boss, an old worsted stocking, tightly tied up in a wad, does admirably. For plain facework the grits are in flat pieces, and are used on edge, traversed over the face. The polishing block is a piece of wood from 16 in. to 18 in. long, and 4 in. wide, with a piece of felt on the underside fastened at each end.

Filtration of Oils by Heat.—Tow, such as brewers use for the filtration of malt liquor, answers well as a filtering medium for viscous fluids. The filtration is expedited by heat, and may be accomplished in the following simple manner. Two funnels are necessary. One funnel is placed inside the other, an indiarubber plug being on the neck of the inner funnel, around which the outer funnel fits. In order that the filtering liquid may be covered, the top of the inner funnel projects somewhat. The tow or paper is placed in the inner funnel, and the interspace contains water, which is kept hot by steam, which passes into it from a flask. The excess of water may be drawn off by means of a constant level syphon, or a strip of web-tape hanging over the outer funnel. The diagram is thus explained:—A is the outer funnel, which contains water, and into which steam is passed for heating purposes; B, inner funnel for filter; C, flask containing water; D, flask to collect filtrate; E, glass tubing (steam from C is passed along the tube to A); F, burner to heat flask; G, tripod stand to support flask.



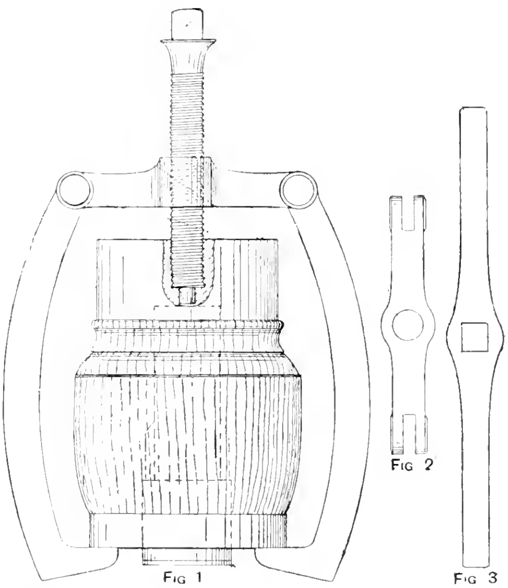
Filtration of Oils by Heat.

Manufacture of Porcelain and Earthenware Goods.—The finer qualities of earthenware or porcelain goods are manufactured from mixtures of various clays, calcined bones, etc., from which every organic constituent has been burned out. All these ingredients are weighed, and mixed together in a large quantity of water, and strained through very fine sieves. When the clay has been allowed to dry till of the consistency of dough, it is placed by the potter on a horizontal revolving wheel, and the lump of clay may become a bowl, vase, or any other article. When the object is sufficiently dry, it is ready for the "biscuit" kiln, or first firing, where it is only partially baked. The design is then painted or printed on—that is, underglaze, or before the metallic glaze has been applied. The ware is now ready for dipping into glaze, literally a form of ground glass which the half-cooked ware, being very porous, readily absorbs. It then undergoes its final firing at a much lower temperature than that of the biscuit oven. All articles are placed in saggars, or receptacles of coarse clay, which are next packed in a kiln: this is simply an oven arranged with flues in such a way as to equally distribute the heat. The fire is not allowed to touch either saggars or ware, as in the manufacture of coarser goods such as bricks or terra-cotta.

Blackening and Bronzing Brass.—To obtain a black colour, dip the brass in a strong solution of copper nitrate or copper sulphate, and then heat on a hot plate or hold the article in a Bunsen flame. To bronze the metal, dissolve 1½ oz. of copper sulphate in 1 pint of water, and pour in a solution of 1 part carbonate of soda in 2 parts water until the precipitate ceases to form. Decant, well wash the precipitate with water, and dissolve it in ammonia until the latter is saturated. This solution is warmed and the article dipped in it as before.

Self-winding Clocks.—Many have been made. Some of these are being continually wound up by means of a fan placed in a tall chimney shaft, up which there is a natural draught that always keeps the fan revolving. The fan is connected to the winding shaft of the clock by suitable gearing of a speed-reducing nature. Other clocks are driven by electricity; an impulse is given direct to the pendulum at each vibration by the closing of an electrical circuit in which is a weak battery made by burying carbon and zinc plates in moist earth. Perhaps the most noteworthy perpetual clock is in the British Horological Institute, 36, Northampton Square, London, E.C. It was made more than a century ago, and is dependent for its motive power on the variations in the density of the atmosphere. A sort of barometer containing many pounds of mercury is suspended from a rocking bar, and the constant shifting of the mercury causes the suspending bar to rock and drive the winding arbor by a rack and pinion. This clock has gone for many years, and has only been stopped to be cleaned.

Machine for Withdrawing Axle Boxes from Wheels.—Fig. 1 shows the machine in position on a stock of a wheel ready to force the axle box back. The top corners are made with knuckle joints, so as to allow of side play to take various sizes of stocks, the top boss-piece being made as Fig. 2, having good stout rivets through the joints. For ordinary work the sides should be made of iron, 1 in. wide by ½ in. thick, with a good broad duck foot at the bottom. The top cross-piece is made with a boss large enough to take a 1-in. screw; this has a collar and square on the top end to take the handle shown in Fig. 3, the bottom end being turned down to $\frac{5}{16}$ in. so as to form a shoulder for the circular bolster to rest upon. In use, the cramp is put on the wheel as shown in Fig. 1; the bolster, which is a trifle smaller than the outside of the box, is put on the end of the screw, and pressure applied by turning the screw down until the box, indicated by the dotted lines, is removed.

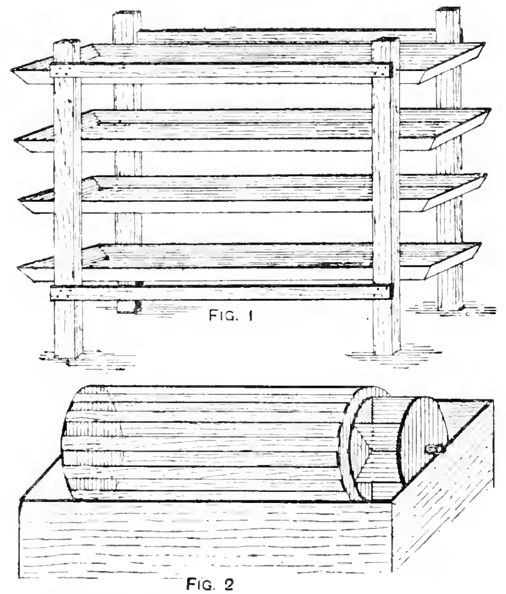


Machine for Withdrawing Axle Boxes from Wheels.

Receipes for Cheap Red and Black Paints.—For a cheap black paint for rough outside work, melt together equal parts of pitch and coal-tar, and thin to a working consistency with coal-tar naphtha. The naphtha may be dispensed with if the melted material is applied hot. A cheap red paint can be made by slaking lime with water and adding sufficient red oxide or Venetian red to colour it; apply it as if applying whitewash. Allow it to dry, and then brush over with silicate of soda solution (1 part of silicate to 4 or 6 parts of water). This paint will be found very durable.

Painting Lines on a Glass Plate.—To paint narrow lines on a plate of glass such as is used for show signs, first clean the side of the glass to be lined with a few drops of ammonia in warm water; then polish with a piece of soft paper, and lay the glass flat. Mix the colour in turps. Dry colour ground in turps is best, bound with japan gold size; do not use more than 1 oz. of gold size to 1 lb. of colour. Put the colour on a piece of glass, and charge the lining pencil with the colour. Let the second finger rest on the edge of the glass as a guide; hold the pencil between finger and thumb, and draw your hand towards you. If only a few lines are to be painted, perhaps it would be better to use a sign-writer's brush, and, when the lines are quite dry, to cut them straight with a straight-edge and sharp chisel. Lining pencils are made from sable hair, are from 2 in. to 2½ in. long, and are called lark, crow, duck, goose, and swan, swan being the largest.

Apparatus for Washing Large Photographic Prints.—Large prints are not generally washed in the mechanical manner adopted for small prints, because of the difficulty of keeping the prints from clinging together, and the impossibility of changing the water with sufficient frequency. Unless some such arrangement as described below is used, each print should be washed by itself. The accompanying sketches show two forms of washing machines for large prints. In Fig. 1 four trays are shown placed in a rack; each tray is in turn tilted to a slight angle to allow the water to run into the tray beneath. The trays may be of enamelled zinc or of wood coated with paraffin wax; they rest on four rails (not shown) supported by vertical posts.



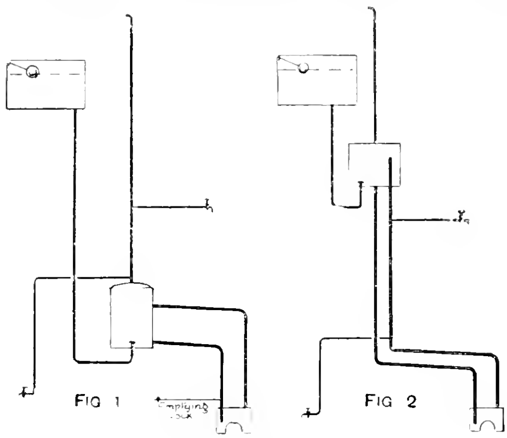
Apparatus for Washing Large Photographic Prints.

Fig. 2 shows an arrangement for washing unusually large prints. In this case the developing tank, being deep and long, may be used as a washing trough. The washing machine consists of two circular discs of wood (the ends of tubs), bored in the centre to receive an axle (a broomstick), at each end of which a disc is fixed, thus forming the framework of a skeleton cylinder, the ribs of which are laths stretching from one disc to the other, and nailed at each end. Around this cylinder the print is fastened with wooden clips. At one end of the cylinder sufficient space is left for a small water-wheel, which may be driven by water from the tap above it. The outflow is regulated by a plug, thus keeping the water in the trough always at the same height.

Making Clinical Thermometers.—These, like ordinary chemical thermometers, are made from special tubing with a capillary bore. The bulb is blown by a mechanical blower. The arrangement for preventing the mercury running back into the bulb is very simple. A very small bulb is blown so that the capillary tube becomes somewhat widened a little above the bulb. While the tube is still hot it is nipped or pressed so that the enlargement becomes much flattened; the flattening of this bulb breaks the thread of the mercury, so that on cooling the mercury in the tube above the constriction remains, while that below runs back into the bulb. On heating, the mercury easily rises through the constriction.

Hoop-iron Bond for Brickwork.—Hoop-iron bond is either a plain band of iron, such as is used to fasten bales of goods, about 1 in. wide by No. 20 gauge thick, or it is stouter, and specially made with triangular stabs in it to cause projections, as in Tyerman's patent. In either case it is usually tarred and sanded, and then laid in the courses of brickwork parallel with the face, one to each half-brick thickness of wall, and at such intervals in height as may be directed by the architect. The object is to strengthen the wall, especially where settlements are liable to take place. Sometimes it is laid in footings only, at other times at the angles of a building; and again, it may be usual as a virtual stringcourse round a building between the successive floors. The only disadvantage that could be caused by its use would be due to rusting if insufficiently protected and laid in a damp wall.

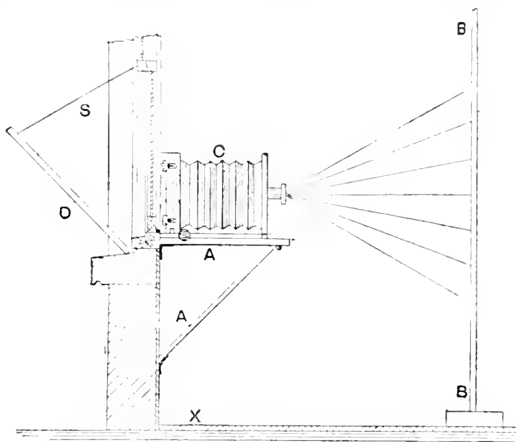
Usual Simple Forms of Hot-Water Apparatus.—The sketches below represent the two commonest schemes of hot-water apparatus in their simplest form. They would be erected thus for small property, and also for large property if some of the many special requirements or conditions to be found in large houses did not exist. Fig. 1 shows the cylinder system of apparatus, to which this name is given because in it a cylinder is nearly always used instead of the square tank. A square tank may be used when the apparatus only extends, say, 12 ft. above it, but when more than this a cylinder is used, because a square reservoir will not bear the pressure. The connections must be made as shown. Draw-offs can be from any point on the expansion pipe up to the level of the water in the cold cistern. The reason the hot water does not run out of the top of the expansion pipe is that this pipe is carried up at least 2 ft. higher than the cold-water cistern which feeds the apparatus. Fig. 2 shows the tank system of apparatus, so called because a square tank is used and not a cylinder, although the latter can be used if desired (the square tank costs less). In this apparatus the tank is fixed above the highest draw-off, and usually only a few feet below the cold-water cistern. The cold service is taken into the bottom of the tank, and an expansion pipe is taken from the top and carried to a height at least 2 ft. above the cold cistern. Draw-offs can only be taken from the flow pipe, not the return, as the latter seldom has hot water in it.



Forms of Hot-water Apparatus.

Tuck Pointing and Re-colouring Brickwork.—The method generally adopted for colouring ordinary brickwork is to apply with a brush a solution of green copperas (1 lb. to 5 gal. of water). This should be tried on a few bricks, and allowed to dry before applying it to the whole front; sometimes two applications are needed. Use, when the bricks are of a superior quality, a wash formed of 1 lb. each of Venetian red and Spanish brown to 1½ gal. of water, in which has been dissolved, while the water is hot, ½ lb. of white copperas, or alum. This should also be tried on a few bricks, and allowed to dry before applying it to the whole front. The joints should be well raked out, and the front washed and brushed with a stiff brush. When the work is dry, apply the colour; and after this has dried, prepare the stopping. The mortar for this is coloured with Venetian red and finely sifted smith's ashes or foundry sand, unless red sand can be procured. This must also be tried on a few joints and allowed to dry, to see that it is of a suitable colour. No more stopping should be done in one day than can be jointed, for if the work is allowed to dry the white putty will not adhere. The putty is formed of finely sifted white lime mixed with linseed oil, and silver sand, or marble dust, the latter being preferable if it can be obtained. The putty is applied with a steel jointer of the width of the joint, on a rule about 7 ft. long. The rule should have three blocks of wood, ⅜ in. thick, on the back, to allow the cuttings from the joints to drop clear. The joints are cut with a knife called a "Frenchman," the end of which is turned up at right angles. The vertical joints are laid on from a board formed like a set square, with a wooden handle on the front, like the handle on a plasterer's hand float. It should reach three courses in height. When the joints are all laid on and cut, go over the work with a soft brush to remove all dust. A sufficient quantity of colouring and stopping should be mixed at one time to cover the whole. The tuck pointing should be ⅜ in. thick.

Enlarging Photographs by Daylight.—For making enlargements by utilising the window of a dark room, construct a bracket A (see illustration) and an upright easel B, running in guiding rails X. Outside the window hinge a reflector D, consisting of a white board about 24 in. by 20 in., held at an angle of 45 with the window sash by a cord S passing through the joint of the window frame. The camera C, preferably one with a movement of front for focussing or a lens with rack and pinion, is placed on the bracket as shown. The ground glass of its focussing screen may be removed and the negative inserted in its stead, or a carrier may be made to fit the slide grooves. Another plan is to place the negative in the dark slide, removing the partition and withdrawing both shutters. The size of the enlargement will depend on the distance of the easel from the negative and the amount of extension of the camera. The finer focussing having been done on a sheet of white paper, make a cap of ruby glass to fit over the lens, pin up the bromide paper on the easel, and, if the position is correct, remove the cap and expose. Light must reach the easel only through the negative.



Enlarging Photographs by Daylight.

Staining Pine to Imitate Chippendale.—To stain yellow pine in imitation of Chippendale mahogany, procure some burnt sienna, ground in water, mix with stale beer, and add a small quantity of vandyke brown and rose pink; mix well together. Apply rather liberally with a brush, then wipe off with clean rag, finishing in the direction of the grain. This will form the foundation. The exact tone required is built up as the polishing proceeds by adding a small quantity of Bismarck brown to the polish to impart redness, black for a darker tone, and rose pink for the peculiar purple tone that characterises some Chippendale goods. The colours should be evenly distributed. Should any difficulty occur in applying them with polishing pads, use a camel-hair brush.

Dissolving Gum Copal.—Copal varies in quality, as hard, half hard, and soft, and gives best results when dissolved in properly heated vessels. Soft gums contain a small percentage of water, and if cold turpentine is added to the gum when dissolved in spike oil, precipitation is the result. Copals do not readily dissolve by cold solvents unless the gums are powdered; they may then be dissolved in spike oil, if thoroughly mixed. To prevent precipitation when thinning out, use one part of spike oil and nine parts of turpentine free from adulteration.

Demagnetising a Watch.—Place the watch over an alternating current transformer so that it is in the magnetic field, and then decrease the current gradually to nothing. Another way is to spin a bar magnet just over the watch and gradually to withdraw it; or the watch may be revolved over the fields of a continuous-current dynamo, and gradually withdrawn from the influence.

Determining Speed of Photographic Shutter.—Choose an object, say the wheel of a bicycle, which may be got to make exactly one revolution per second. Fasten to one of the spokes near the tyre a disc of bright tinfoil, and focus the wheel as large as the plate will allow. When the wheel is making one revolution per second release the shutter. Now, without altering the camera, make an exposure with the wheel at rest to serve as a measuring chart. On development it will be found that the first exposure shows an arc or smudge of light. The proportion which this arc bears to the complete circle is the proportion which the shutter exposure bears to one second, so that all that remains is to measure the arc with a pair of compasses and divide the circumference by it. For a brief exposure of less, say, than one-fiftieth of a second, it is necessary to have a special arrangement by which a wheel can be rotated at a much higher speed and with greater certainty.

Fastening Legs to a Bamboo Table Top.—Fig. 1 shows a simple method of fastening the legs. Strips of deal or other suitable wood are bored to receive the top ends of the legs, which are glued and fastened with a sprig as indicated. The strips should be halved and glued together where necessary (the halving of one piece is shown at Fig. 2), and secured to the underside of the top with a few screws.

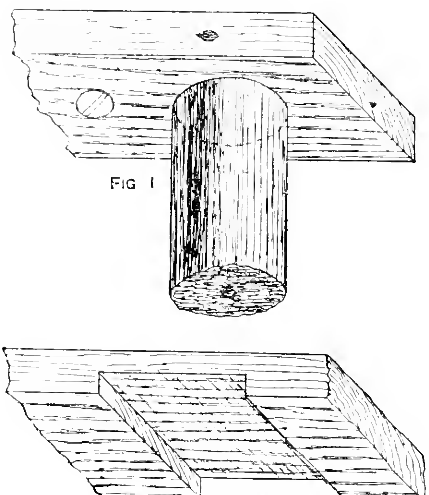
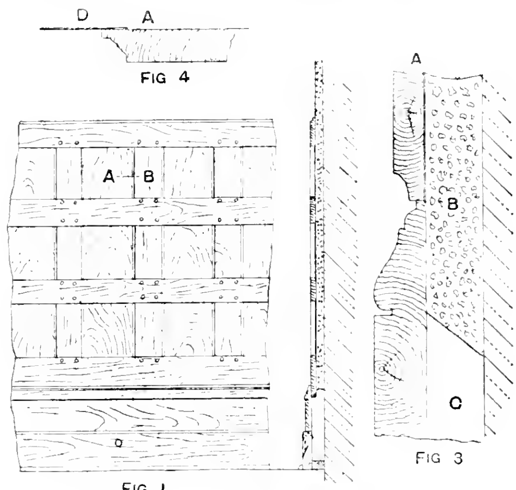


FIG. 2

Fastening the Legs to a Bamboo Table Top.

Timber-framed Buildings.—There are many ways of constructing these, but three methods adopted where cost is a consideration are as follows:—(1) Planting 7 in. by 2 in. deals on the face of a wall; (2) framing timbers together the half thickness of the wall and then filling in the panels with rough deal studs to receive the laths and plaster; and (3) using metal lathing instead of the ordinary deal laths. These methods have only cheapness to recommend them. To properly construct such a building, the timbers of all the angles should be the full thickness of a 9-in. wall, in fact, 9 in. by 9 in.; sills, 9 in. by 6 in.; heads, 9 in. by 6 in.; other timbers, such as curved pieces, studs, and rails, 6 in. by 4 in. The timbers are grooved on the sides, jointed together by the mortise and tenon joint, and secured by 1-in. oak pegs, to project ¾ in. from the face of the wood. The sills should project 1½ in. from the face of the brickwork, and be moulded and throated on the edge. Between the timbers—that is, in the panels—this is filled with 1½-in. brickwork, 1 in. back from the face of the wood, to allow of sufficient room for the stucco. Behind the whole of the timber framing another 4½-in. wall is built, to make it the full thickness of the wall below; consequently the timbers that are the full thickness of the wall will be seen from the inside, which should be covered with flat-headed nails to form a key for the plaster. After this, the outside of the panels is covered with Birmingham adamant cement work to [illegible] in. in thickness, the groove in the timbers acting as a key. The timbers are coated twice with Carbolineum Avenarius, once before fixing and once after, so that the blackness of the timber may contrast pleasantly with the whiteness of the plaster. Memel, deal, pitch pine, and oak are each used in the construction of half-timber framing. Good red deal, if it were possible to obtain it in the sizes required, would be preferable to pitch pine, which is liable to crack and open under the influence of the weather, but the use of deal is, from the cause already mentioned, greatly restricted, pitch pine being chosen instead. In the majority of cases, oak is out of the question on account of its cost; but, if a good job is required, and when expense is not a prominent consideration, oak is the wood to be used.

Method of Panelling with Veneers.—Wood panelling, although a very suitable and much-used enrichment, is generally very costly. The following is a strong and effective method of fitting it at a greatly reduced cost. First cut some oak veneer into sheets about 2 in. longer each way than the required panels. Mark the lines of the framing on the wall, and glue these sheets to the plaster, overlapping the marks 1 in. all round. The wall having been previously plugged, fasten to it pieces of oak, each about 4 in. by ¾ in., to form the framing, which thus holds the veneer. The joints between the rails and stiles are merely butted.



Method of Wood Panelling with Veneers.

Sham pins, either cut off flush or left projecting for ¼ in., may be added if desired. Fig. 1 shows an elevation of panelling with an old-fashioned treatment of the mouldings, consisting of a double fillet and chamfer run on the upright members only, and butting on the horizontal ones, which are left square. Fig. 2 is a section illustrating the new method of fixing the framing. The panelling is solid, leaves no space to harbour vermin, and can be polished, stained, or otherwise finished in the same manner as ordinary panelling, while its cost is considerably less than one-third that of the latter. A further advantage is that, as it is much thinner than ordinary work, the skirting, if already fixed, need not be taken up and brought forward; for with suitable mouldings on the bottom edge of the bottom rail of the panelling a neat junction may be effected. Fig. 3 shows a method of treating mouldings for this purpose, while Fig. 4 is an enlarged detail section on the line A B in Fig. 1. In Figs. 3 and 4, A represents the framing, B the plaster, C the ground, and D the veneer. If a bolection moulding is preferred, it should be remembered when designing it that the general character of a moulding arises from the contrast of curves with sharp edges; and, at the same time, the chief divisions of the mouldings should not be equal in size, as this tends to produce a coarse effect. Two or three small delicate mouldings, followed perhaps by a bold ovolo or scotia, and then by smaller mouldings again, should, if properly managed, give that idea of richness which mouldings are intended to convey. It may be noted that oak-wood panelling is, as a rule, better left rough from the scraper, and, except when it is to be polished, not touched with the glass paper, as this clogs up the grain.

Painting Clock Dials.—To repaint clock dials, all the old paint must first be removed, and the plate cleaned thoroughly from grease. The white ground can be painted with white enamel, obtainable in 3d. and 6d. tins. These enamels dry hard and glossy. The figures may be painted with black enamel, with a fine camel-hair brush. If only a single dial is to be painted, the figures may be spaced out on a piece of paper a little smaller than the dial plate; when this paper is laid upon the dial to be painted, the marks can be easily transferred to the minute circle.

Covering a Small Roof with Zinc.—A small roof of the shape indicated in Fig. 1 may be covered as shown in Fig. 2, which is a section across one roll at A—B (Fig. 1); Fig. 3 is a section on C—D of the end roll showing apron to weather the joint to brick at the gable end; and Fig. 4 a section on E—F showing the eaves dripping into a zinc gutter. In section Fig. 2, G is a tack or clip about 2½ in. to 3 in. wide, H the stand-up of the bay, J the roll cap, and K a fork or pointed strip with one end soldered to the under side of roll cap. On sliding the latter into its position, the loose end of the fork passes under the clip G and thus forms an invisible fixing. The top ends of the bays are turned up against a ridge roll which has a capping similar to A—B. If the ridge roll stands up about 1½ in. to 2 in. above the others, the saddle pieces shown at L (Fig. 1) are unnecessary. For fixing the eaves gutter, bridging pieces of zinc tube are soldered in, and through these long screws are passed for fixing to the ends of the boards, or to a fascia board if one is used.

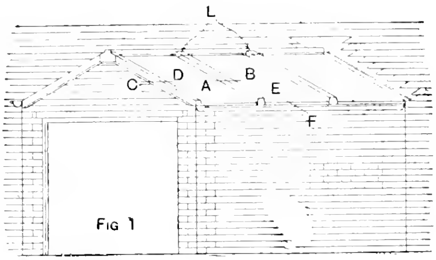


Fig 1

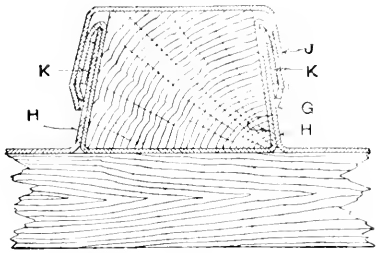


FIG. 2

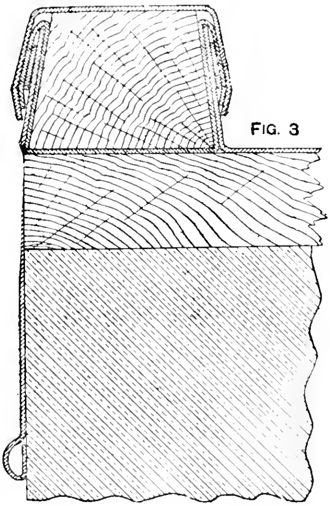


FIG. 3

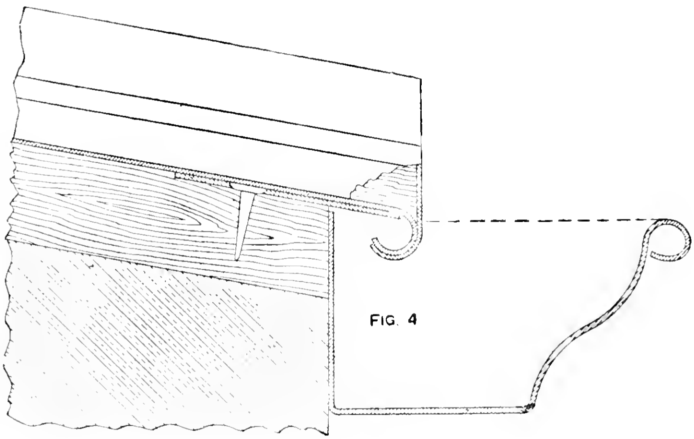


FIG. 4

Covering a Small Roof with Zinc.

One-solution Developers for Photographic Negatives.—These developers are usually employed for the development of snapshot exposures, and are therefore compounded for under-exposed plates. The following are given in grains per ounce, from which any quantity may be made up by first finding the capacity of a suitable bottle and multiplying each item by the number of ounces. Use just sufficient hot water to dissolve, then fill up the bottle, shaking occasionally. No. 1: Sulphite of soda, 100 gr.; yellow prussiate of potash, 1 gr.; hydroquinone, 25 gr.; caustic potash, 10 gr.; water, 1 oz. Dissolve the potassium hydrate separately. Use 1 part with 3 parts water. Where more exposure has been given, as much as 9 parts water may be used and 10 drops per ounce of 10-per-cent. solution of potassium bromide. No. 2: Sulphite of soda, 75 gr.; carbonate of potash, 100 gr.; glycine, 20 gr.; water, 1 oz. Add glycine last. Use 1 part with 3 parts water. No. 3: Sulphite of soda, 50 gr.; water, 1 oz.; amidol, 5 gr. The soda should be kept as a 10-per-cent. solution, and the amidol added only when required. No. 4: Metol, 3 gr.; sulphite of soda, 10 gr.; hydroquinone, 1 gr.; carbonate of potash, 20 gr. Dissolve the metol first. Use 1 part with 1 part water, and, if necessary, 2 drops per ounce 10-per-cent. solution of potassium bromide. The following formula for a single fluid developer which will not stain the fingers may be used for either plates or paper:—Dissolve 24 gr. of metol in 10 oz. of distilled water, add 1 oz. of sodium sulphite, 40 gr. of hydroquinone, and ½ oz. of carbonate of potash or soda. For use, take one part of developer and one part of water and add 1 drop per ounce of 10 per cent. solution of bromide of potassium. It is preferable to increase this to 4 drops per ounce for bromide paper.

Renovating Plaster Bronzes.—Brush them carefully with a soft brush and paint the surface with gold size, and, when this is sticky after standing a short time, apply the bronze powder with a pad of chamois leather. Dry in an oven till the coating is hard, then apply copal varnish and finally stove the bronzes.

Cementing Leather to Iron.—For uniting leather to iron, use marine glue, which is made by dissolving 1 part of pure indiarubber in 12 parts of coal-tar naphtha. After solution is complete, add 20 parts of powdered shellac; warm the mixture gently, and stir from time to time until properly amalgamated. As the naphtha is very inflammable, the heating should be done in a steam bath in a closed pan. When made, the cement should be poured on a cold stone and allowed to set. Before applying the cement to the iron, the latter should be roughened with a file and heated. The leather also should be roughened on the back with glasspaper, drawn tightly over the iron while the cement is still pasty, and pressed into position until it becomes cold. Rubber tyre cement is practically a marine glue, and it may be obtained from most cycle-repairing depots.

Making Gelatine Moulds.—When making gelatine moulds for casting plaster ornaments, etc., the glue or gelatine must be of good quality; it is soaked in water till soft, and melted over the fire in the usual way. The gelatine must be of just sufficient consistency to pour from the can and enter into the finest markings of the model. The mould should first be dusted over with French chalk, which is afterwards carefully brushed off. Before pouring in the plaster, oil the mould with paraffin oil in which a piece of composite candle has been melted. This will put a clean, smooth skin on the mould, and prevent the plaster from sticking. The cast should be removed from the mould as soon as possible, and before the plaster begins to heat. The mould will peel or scale on the casting through using poor gelatine, through not oiling the inside of the mould properly, through allowing the plaster to set and become warm before being removed, and through using the gelatine too thin.

Self-feeding Poultry Food Bin.—Fig. 1 shows a section and Fig. 2 a front view of the bin, which may be made of ¾-in. pine. The sides are made with the grain of the wood running from top to bottom, a ledge being nailed across the lower and top edges to prevent warping. A A (Fig. 2) show the lower ledges, those at the top being inside. The front (A, Fig. 1) extends from the top to a little less than half the depth, and from this a piece of tin forms the front of the hopper and reaches to the feed-hole B (Fig. 1), which should be of such a height from the ground that the poultry can reach the grain. The feed-board is hinged to the back of the hopper at C, the joint being protected inside by a strip of canvas. A batten D is nailed across the grain of the feed-board to keep it from warping, and is extended through to the back, where a bolt with a thumbscrew is provided which may be turned to regulate the size of the feed-hole B to suit the size of the grains of corn that are being used. The sides are cut away in the centre at E to give a firmer bearing on the ground. A sloping roof is provided, fitted with hinges at the front and a hook and eye at the back.

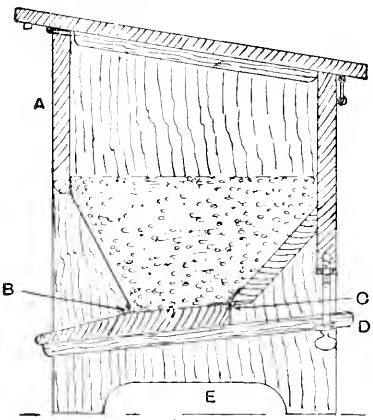


FIG. 1

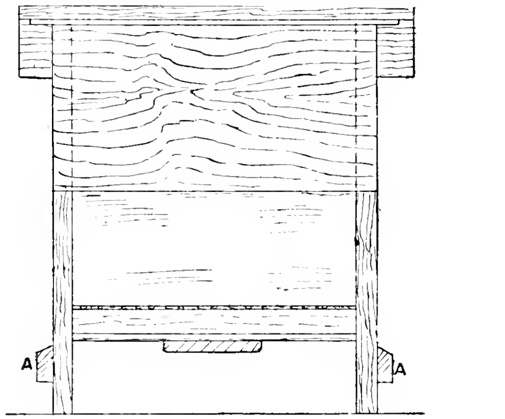


FIG. 2

Self-feeding Poultry Food Bin.

Meaning of Tension, Compression, and Strain.—A body is in tension when a force, acting on it parallel to its axis, tends to separate its particles by drawing them apart. A compression force is one that acts parallel to the axis of the body and tends to force the particles into one another. In short, a body in tension has a pulling force upon it, while, if in compression, a push would be exerted on it. A strain was at one time considered as a force acting on a body, but the more modern idea is to consider it as the change of form in a body due to the application of a force.

Speed of Photographic Shutter.—There is no fixed speed at which a photographic shutter should be worked, because so much depends upon the strength of the light, the aperture of the lens, the speed of the plate, and the rapidity with which the objects it is desired to photograph are moving. The exposure will generally be as long as the moving objects will allow. When the distance from the camera to the moving object and the speed at which it travels are known, an excellent rule is as follows:—Divide the distance between the camera and object (in inches) by the focus of the lens multiplied by 100, and divide the result by the rapidity of motion (in inches) to obtain the answer in the fraction of a second. Thus, if the distance of object is 720 in., the focus of lens 7 in., the rapidity of motion 20 miles an hour or 352 in. per second; then $x = \frac{720}{700 \times 352} = \frac{1}{340}$ of a second, which is the speed at which the shutter must be worked to obtain a sharp image, assuming that the greatest amount of blur or confusion admissible in any point of light must not exceed $\frac{1}{100}$ part of an inch. It then only remains to find what lens aperture and plate will allow of so brief an exposure being given on such a subject and in such a light. For example, if $f/8$ at 12 noon in June requires $\frac{1}{15}$ of a second to secure desired density of negative, etc., then $f/5{\cdot}6$ will be the nearest stop to give the correct result at the same time.

Black Paint for Lettering on Glass.—To make a black liquid suitable for writing letters on opal glass, take ½ lb. of lampblack, dry, and place it on an iron plate, well saturate it with turpentine, then set fire to it and let it burn itself out. This will remove the grease—the non-drying oil—from the colour. Now grind it in hard drying mastic varnish, and thin with turps. It would be better to give the letters two coats of thin colour rather than one thick coat.

Dyeing Fancy Grasses Various Colours.—Allow the grasses to soak for some time in a very hot and strong solution of aniline dye in water. Those dyes which are not soluble in water may be dissolved in spirit, and the solution added to water. Some aniline dyes will colour direct in this way, but others require a mordanting or fixing agent. For fixing basic dyes, such as magenta, methyl violet, etc., the grasses should first be soaked in a hot solution of oak bark or of sumach. Many pretty shades may be obtained by first soaking in a hot solution of picric acid, and then in magenta, methyl violet, methylene blue, etc. For green, picric acid and indigo extract may be used. In all cases the dye solution should be strong and hot, or the dye will not penetrate. The grasses should be quickly dried after soaking in the colours.

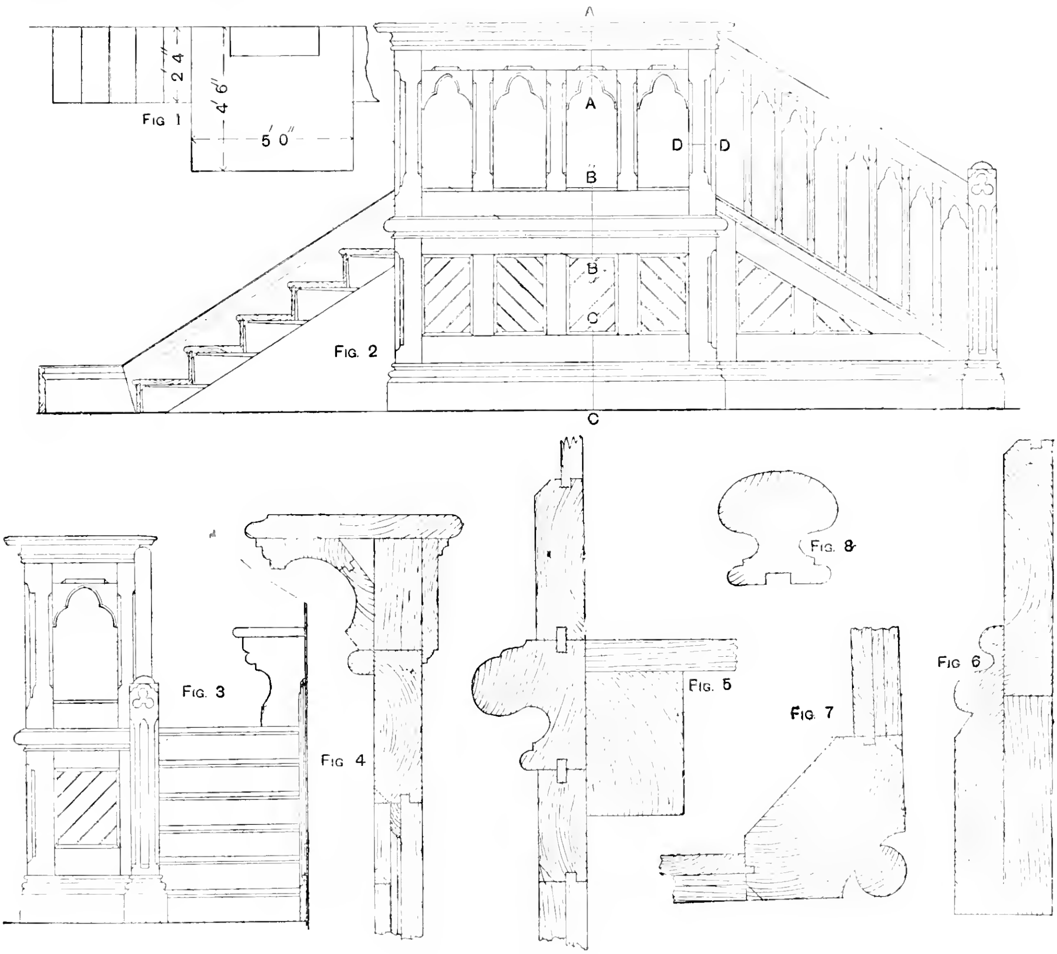
Tempering Cold Setts for Cutting Steel Rails.—The methods of tempering ordinary engineers' cutting tools are suitable for setts. Warm water is preferred by many, but cold water gives a harder temper. Water which has been long in use is better than fresh water. Chemicals are not necessary, though a little rock salt added is said to be advantageous.

Colouring Malleable Castings.—A good green colour is obtained on malleable castings by blackleading the castings, and then lacquering them, when heated, with a green lacquer. Or they may be painted over with bronze powder, which may be obtained of various colours and tints, rubbed up in best varnish, and heated in a hot japanning stove. But the best way is to have them bronzed by electro-deposit of copper, brass, or other metal; or they may be tinned in the ordinary way, and then lacquered with yellow or gold lacquer when heated in a stove or on a hot plate.

Fixative for Pencil Drawings.—Pencil drawings made on ordinary drawing paper may be protected from smudging or becoming blurred by a thin coating of methylated spirit into which some resin has been dissolved. The varnish may be applied with a brush, but a better way is to blow it on with a spray, which may be obtained at any chemist's. A wash of milk over the drawing will also serve to fix it.

Varnish for Kitchen Chairs.—Such chairs are generally made of birch; the commonest kinds are brushed over with glue size stained with venetian red, then varnished with common varnish heavily stained. The better kinds are stained with burnt sienna and size or stale beer, then bodied up with red polish and varnished. One pennyworth of Bismarck brown, added to 1 pt. of varnish, imparts a powerful red tone. Shellac 4 oz., resin 2 oz., benzoin 2 oz., and methylated spirit 1 pt., make a useful varnish. Carefully strain. If the varnish is not thick enough, add more shellac; if it is too thick, add more spirit. Apply with a camel-hair brush.

Design for Small Pulpit.—Fig. 1 shows a sketch plan, Fig. 2 shows front elevation, with a portion removed on the left in order to show the stairs. Fig. 3 shows the side elevation. Enlarged details are given as follows:—Fig. 4, section through AA; Fig. 5, section through BB; Fig. 6, section through CC; Fig. 7, section through DD; and Fig. 8, section of handrail. The construction is fairly simple, but the pulpit would look effective if made of good deal and stained and varnished, or of pitch-pine varnished.



Pulpit for Small Chapel.

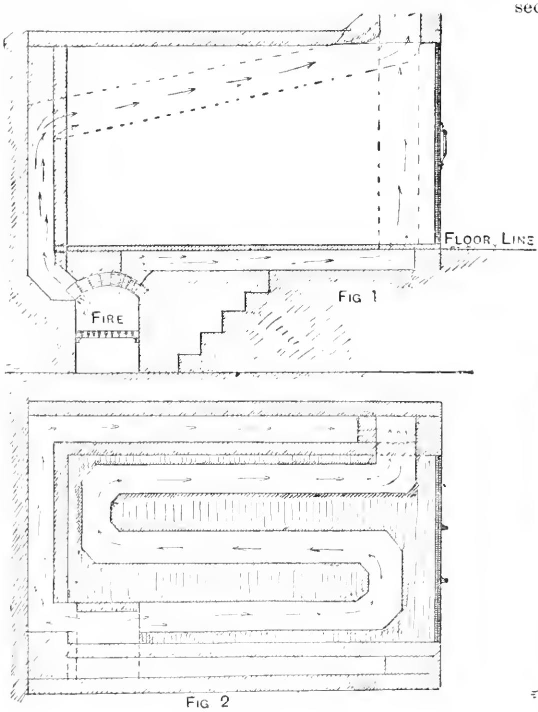
Painting a Cart.—To be used for trade purposes, it would look very well with the body painted chocolate lined out with vermilion; the under parts, such as shafts, wheels, etc., being painted a light yellow, picked out with a broad line of black, edged with vermilion. Another colour for hard wear and to look well is a good dark green, the body fine-lined with a lighter green, and the under parts picked out with the same colour as the lines on the body, and edged up, or gauged off with a fine line of a straw colour. Blue cannot be recommended for the purpose, as it has a tendency to fade and turn white; but if used for the body it should be fine-lined yellow and the under parts painted red picked out in black. In pleasure carts it is customary to have the bodies black, without any lines at all, excepting the front seats and brackets, but the kind of vehicle determines in a great measure the manner in which it is to be finished. It may perhaps be as well to add that the broad lines on a trap, usually on the centre of the spokes, shafts, and springs, represent "picking out," whilst fine lines are the smaller ones sometimes used by themselves, when they are called counter-lines, and at other times edged on the picking out, or run up the centre of the same, when they are termed split lines.

Boring Holes in Bricks.—For boring holes about ½ in. or ¾ in. diameter at any place in an ordinary brick wall, an old twist-bit used as a boring tool may be made to serve the purpose: a piece of steel tube, such as cycles are made with, will, if jagged at the end, answer very well. These tools are only suitable where the bricks are fairly soft; with hard bricks it is quicker and easier to make holes with a chisel and hammer in the usual manner. Holes may be very quickly drilled in brick or stone walls by making the cutting end of the drill in the form of a cross with four cutting edges. The drill is held in one hand and rotated while being struck with a hammer. When the holes are required to be deep, a projection may be made on the outer end, by which it can be knocked out of the hole quickly. The cutting end should be larger than the shank, so as to allow for clearance, and the shank should be sufficiently long to allow a hammer to be used for knocking it out of a deep hole.

White Cement Floor.—For making a hard white cement floor for a room, lay an ordinary cement concrete foundation, about 5 in. thick (4 to 1), and on this lay a coat, 1 in. thick, of Portland cement and clean white sand (1 to 1). Such a floor has a white appearance when dry.

Efficiencies of Water Motors.—For small power purposes, for pressures of 50 lb. per square inch and upwards, if efficiency is defined as the ratio of the work received from the motor compared to that put into it, the following list may represent the efficiencies of various water motors when used in circumstances that suit the special types considered:—Undershot wheel, 25 to 45 per cent.; low breast, 40 to 65 per cent.; Poncelet, 60 to 70 per cent.; high breast and overshot, 60 to 80 per cent.; and turbines from 60 per cent. upwards. Undershot wheels and Poncelet wheels are suitable for heads of 6 ft. and under; breast wheels for heads over 6 ft.; overshot wheels, from 10 ft. to 60 ft. or 70 ft.; and turbines for any head according to the design of the wheel. A pressure of 50 lb. per square inch corresponds to a head of $50 \times 2 \cdot 31 = 115 \cdot 5$ ft. The Jonval (parallel or axial flow), Fourneyron (outward flow), Thomson (inward flow), and Schiele (mixed flow) turbines are suitable for pressures.

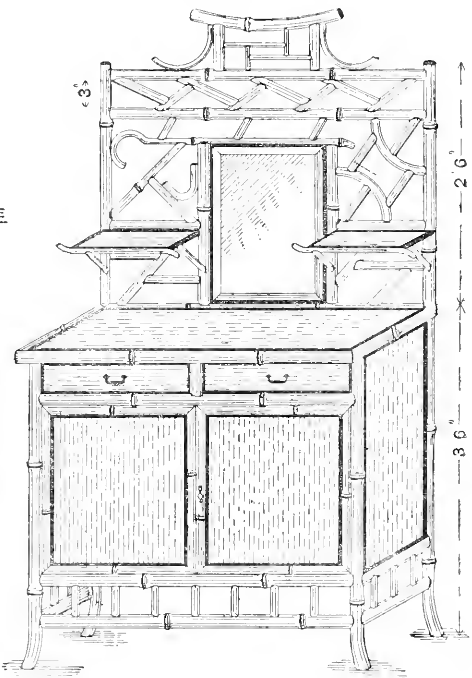
Hot-air Oven.—The modern hot-air oven suitable for enamelling and japanning here shown is about 10 ft. by 8 ft. by 7 ft. high, with iron swing doors in front. An ordinary furnace fire, fire-brick lined, is built at the further end of the oven opposite to the smoke flue (see Fig. 1, which is a longitudinal section), access to this furnace fire being obtained by a flight of brick or stone steps. Ordinary furnace bars form the grating, with a cast furnace door in front. From the right-hand side at the back of the fire-box the brick flue is carried in the brick floor, as shown on plan (Fig. 2), crossing the floor three times, and then up the side wall into the smoke flue. These flues are covered with fire-brick slabs in the usual manner, forming the floor of the oven. On the left side of the back of the fire-box a similar flue is built into the back wall in a direction slanting upward; this is carried along the side wall, and thence into the smoke flue. Doors should be fixed in suitable positions for the cleaning of the flues. If more convenient to have the smoke flue in another position, it is only necessary to alter slightly the direction of the flues. The size of the furnace must depend on the size of the oven adopted.



Hot-air Oven.

Making a Hair Mattress.—The top of a hair mattress is made of sateen Leeds ticking, bordered with fancy striped Belgian. The underside can be covered with fine hessian, but if made of the same material as the top the mattress can be reversed. Seam the material to the required width of the mattress, then machine on a border of Belgian all round, 5 in. wide; this will give the mattress a thickness of 4 in. Let the stripe of the border run the opposite way to the cover. Fold in the corners neatly, and make a small roll by running a seam ¼ in. from the outside edges all round the top and bottom. For best work these rolls are piped with cord. Fill the mattress with curled hair, and tuft in rows 6 in. apart with strong twine and red woollen tufts. To make the mattress square and firm at the edges the sides are stitched up with two or three rows of blind stitches. For this purpose an upholsterer's 9-in. double-pointed mattress needle, threaded with twine, must be used, the needle being passed through the side about 1 in. from the bottom edge, and brought out, but not drawn through, 6 in. from the edge on the top; the needle is then, being double-pointed, backed out on the side about 3 in. from the place at which it was first inserted. When the needle is pulled up tight all the hair contained in the stitch is drawn up to the edge of the mattress. Stitch all round in this way as many times as necessary.

Design for Bamboo Cabinet.—In the accompanying sketch the uprights of top are 2 ft. 6 in. long, the cross rails 3 ft. 3 in., and the mirror 20 in. by 15 in. Use 1¼-in. or 1½-in. canes for the work. Make up the front and back of the cabinet in the first place, and, while these are setting, get out the back of the top. The two bottom sections should now be joined together. The rails should be about 10 in. between if the cabinet is to be 13 in. wide over all. Make the door frames from perfectly straight 1-in. canes. These canes should be mitred at the corner, and a right-angle dowel should be used for filling. The rebate for the glass should be formed with split black cane. The doors work on pins, which act as pivots.



Design for Bamboo Cabinet.

Renovating Brasswork of Bedstead.—Take the loose brasswork to pieces and boil off the old lacquer in a hot solution of carbonate of soda and water—1 lb. of carbonate to 1 gal. of water; then swill the parts in clean water. Repolish with strips of flannel "list," to which is applied a mixture of lime and oil. Then clean off with dry lime, and relacquer with a camel-hair brush. The work should be held in some way, preferably in a vice.

Darkening a Mahogany Picture Frame.—To darken a Spanish mahogany picture frame, dissolve 1 oz. of bichromate of potash in 1 pt. of warm water. Apply the solution with a sponge or brush, getting it well into all quirks or hollows; wipe off any surplus with rag. Several coats may be given till the desired tone is gained. When dry, wipe over with raw linseed oil; smooth down by well rubbing with coarse rag or finest-grade glasspaper. The work may be finished with French or wax polish.

How to Make a Pencil Marking Gauge.—This tool is not generally found among woodworkers' tools, but if it were more adopted it would be found an advantage over the common rough way of using the fingers and pencil as a gauge. It will be seen from the figures that there are several ways of making the tool. Any hard wood will do for making this gauge, but beech is preferable. A piece of wood about 1 ft. long and 1 in. thick (see Fig. 1) should be chucked in the lathe for the stem of the gauge. This is carefully turned to ¾ in. in diameter, except the end nearest the back poppet centre, which is left a trifle thicker than ¾ in., so that the head of the gauge may be turned on it. For the head a piece of wood 3 in. square and 1½ in. thick will be required; two lines drawn from the corners will determine the exact centre of the block. At the centre on one side of the head a hole should be bored ¾ in. in diameter with a sharp centre-bit half through; the block is then turned over, and the other half bored; this ensures the hole being true. The corners should be cut off the block, so that it may be more easily turned; it is then fixed tightly on where the stem was left thicker; it should be a tight fit. The head should now be turned, so that when finished it is just 2½ in. in diameter. To improve its appearance, the sides of the head may be polished while it revolves in the lathe; but before this is done the top and bottom of the head should be turned

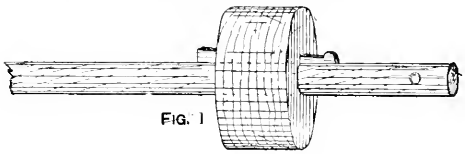


FIG. 1

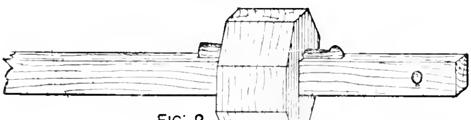


FIG. 2

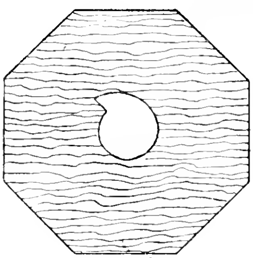


FIG 4

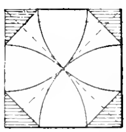


FIG. 3

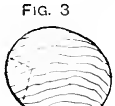


FIG 5

How to Make a Pencil Marking Gauge.

perfectly square to the stem, and as smooth as possible, so that when finished the head should measure 1¼ in. thick. The stem should then be turned, so that the head slides along its length without being too loose; the stem is then cut off about 10 in. long, the ends being cut square. Fitting the wedge is next to be done; it may be shaped with a chisel or fret-saw. The round on the thin end is to prevent the wedge when loosened from slipping out and being lost. The wedge should be 3 in. long and about ¼ in. thick. The groove in the head is cut to take the wedge; this may be done with a key-hole or fret-saw, finishing with a chisel; the wedge should fit easily without any shake. A hole the size of an ordinary pencil should be bored in the stem about ¼ in. from the end; a piece of pencil is fitted in, and the gauge is complete. The gauge illustrated in Fig. 2 is octagon in shape. A piece of wood 10 in. long is planed up ¾ in. square each way for the stem. The head being octagonal, it is best to make it square first; it should measure 2¼ in. When perfectly true, the corners are cut off; it should be marked as shown in Fig. 3. This is done with a pair of compasses. Using the corner of the block as centre, and the middle of the block as radius, an arc is described to the side of the block; a line from the ends of these arcs marked across the corners, should make a true octagon. A square hole to take the stem should be cut with a ¾-in. chisel; a ⅜-in. hole should be bored through first to facilitate the cutting. Care should be taken to get the sides of the head square with the stem when it is fitted in. The head should also slide up and down the stem easily without side play. The wedge is cut to shape, and fitted as described for the round gauge; and the pencil is also fitted as described before. A good way to sharpen the pencil for these gauges is with a sharp chisel. It will be found that the gauge will be handy in using up odd ends of pencils. A different way of making it, which answers well, and is less trouble to alter, is shown at Fig. 4, which gives the end view of the head, showing the shape of the hole. The stem is cut the same shape as the hole in the head, but slightly shorter in the flange of the snail. To make the stem, take a piece of wood 10 in. long, place the head on one end, and mark the shape of the hole on it. Do the same at the other end, and then plane the wood to an oval, as shown in Fig. 5. Cut a slot in it with a fine-backed saw, as shown by the dotted lines, and round off the inner corner. This gauge does not require a wedge to tighten it, but is fixed at any desired part of the stem by turning round, the shape of the stem acting as an eccentric. To loosen it, turn the stem in the opposite direction.

Frame for Working Embroidery.—The accompanying sketches of a corner and back view will give an idea of how to make a suitable frame on which to work embroidery. The tenon A (Fig. 1) is cut, not in the middle, but towards one side of the piece of wood, to allow space for a groove to admit the wedge shown at Fig. 2. The

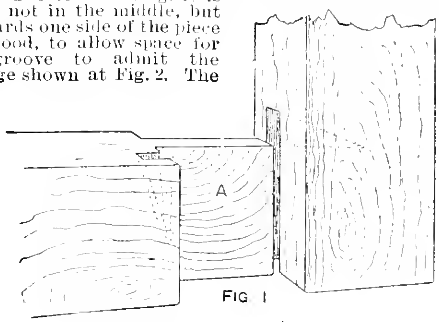


FIG 1

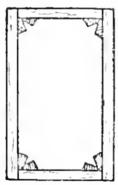


FIG 3

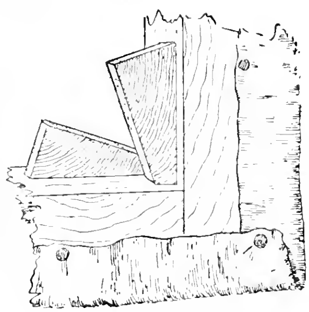


FIG. 2

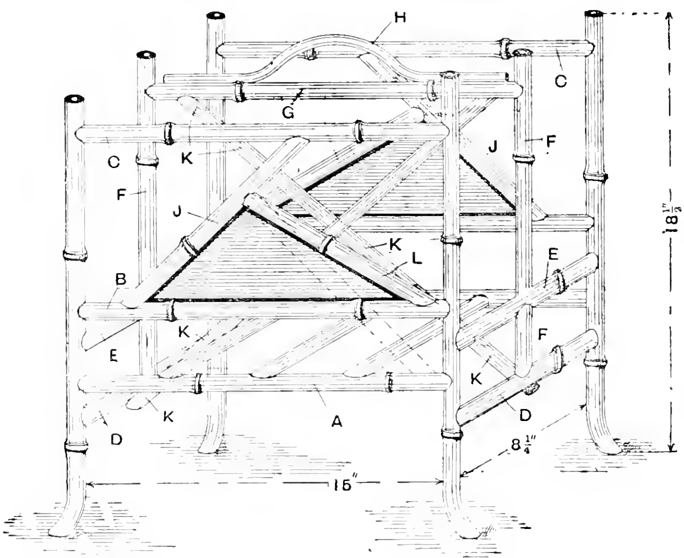
Frame for Working Embroidery.

dotted part shows how this groove is to be cut. The mortise is first cut to fit the tenon, and a piece chiselled out afterwards as shown by dotted lines. This space is for the second wedge. Fit the frame together, and tack the cloth on which the embroidery is to be done as shown at Fig 2, and, if the hard wood wedges are then inserted, it will be seen that by tapping them with a hammer they will expand the framework in every direction, and thus strain the cloth quite equally. Fig. 1 represents a corner of the frame; Fig. 2 a corner with wedges inserted and cloth tacked on; Fig. 3 is a back view.

Making thin Glass Covers for Microscope Slides.—The semi-fluid glass is first blown out into a very large thin bulb and the blowpipe swung from side to side until the bulb elongates into a cylinder. The rounded ends of the cylinder are cracked off by applying a red-hot iron wire, and, with a straight wire, a longitudinal crack is made from one end of the cylinder to the other. The cylinder is placed on a flat stove in an annealing kiln for a few moments, when it softens and opens at the crack, gradually flattening out into a thin sheet. The circles are made by touching the thin sheet with a hot iron wire bent in the form of a circle, and the squares are cut out by applying hot, straight wires.

Deadening Sound coming through Party Walls.—The fault of sound coming through a party wall generally does not lie so much in the wall itself as in the joists. It will probably be found that the joists rest in the party wall, possibly touching each other, and that the sound is conveyed by the timbers, not by the brickwork. The skirting boards, too, may be acting as sounding boards. If this is the case, "jack up" the end of each joist, take out the brick below the end of it, and insert a thinner brick, with two layers of tarred felt between the brick and the joist, at the same time wedging a piece of felt between those joists that touch each other. The skirtings should be taken off, and the space behind filled with plaster. If the cause is really in the walls and not in the joists, try covering with one of the thick pulp papers, such as Lincrusta-Walton, anaglypta, or Japanese leather paper.

Newspaper Rack in Bamboo.—The rack shown in the accompanying illustration has four corner posts, each 19 in. long, slightly bent at the bottom to form the feet. The posts are connected by three rails A, B, and C, back and front, each $15\frac{3}{4}$ in. long, and at the sides by rails D and E, each 9 in. long. There are also three cross rails running from front to back connecting the rails A. The rails E and the posts F (the latter being $13\frac{1}{2}$ in. long) are halved where they cross. Connecting the posts F is a rail G $15\frac{3}{4}$ in. long, to which the handle H, of $\frac{3}{8}$-in. cane, is fastened. Running from the rail G are two $\frac{1}{2}$-in. canes K, each about $19\frac{1}{2}$ in. long, pinned together where they cross, and fixed underneath the rail D. An inclined rail J runs from B to C, the lower end being $1\frac{1}{2}$ in. away from the corner post and the upper end being $5\frac{1}{2}$ in. Another rail L, 9 in. long, inclined in the opposite direction, meets the rail J about $3\frac{1}{2}$ in. from the top, and in the triangular opening thus formed panels are fixed. The dotted lines indicate how the cane L might be fixed if a variation in the design is desired. In this case the rail B would terminate where it meets L. The centre of rail A is $6\frac{1}{2}$ in., and the centre of B $9\frac{1}{2}$ in., from the ground, and the distances between centres of D and E $3\frac{1}{4}$ in.



Newspaper Rack in Bamboo.

Sharpening a Cabinet-maker's Steel Scraper.—A scraper, to be of any use, must have the edge as keen and sharp as possible. The contrivance shown in Figs. 1 and 2 for trueing the edge of a steel scraper does away with the necessity for a vice, or even a bench. It is so simple that it can be used without risk of rounding the edge of the scraper. It is easily made from a piece of any kind of hard wood, 4 in. long, $3\frac{1}{2}$ in. deep, by $1\frac{1}{4}$ in. thick. Dress up the piece of wood to size, and cut out the slot A (Fig. 1). The slot should be wide enough to allow a flat, fine cut file being easily slipped through, and it should also be twice as long as the file is wide, so that the full breadth of the file may be made use of for trueing purposes. Bore a $\frac{1}{2}$-in. hole through the block, and square it out as shown at B; this is to take the wedge W (Fig. 2) which holds the file F in position. The square hole should be slightly tapered, so that the wedge can be easily released. Run a saw kerf straight through the block B down to the slot, as shown at C (Fig. 1). The kerf should be just wide enough for the scraper S (Fig. 2) to slide freely; then a few rubs backwards and forwards will produce an edge which cannot be otherwise than square with the face. It is somewhat difficult for the novice to hold the scraper perfectly upright, so as to prevent it from swaying from side to side on the oilstone whilst setting up the edge. A block something similar to Fig. 1 could be adapted for holding the stone, or even a square piece of wood might be held on the oilstone to act as a fence for the scraper; this at least would preserve the squareness of the edge. It is when the scraper becomes too dull and rounded on the edges by repeated applications of the "steel" that the edge requires to be turned over to an acute angle with the face. The proper instrument for turning over the edge of a scraper is a currier's "steel," which is a hard-tempered and highly burnished little tool. Lay it flat on the bench, with the edge projecting $\frac{1}{2}$ in. or so; hold it firmly to keep it from shifting; grasp the "steel" with the right hand, handle downwards, and work it along the edge. The "steel" should be held almost perpendicular: an angle of 80 degrees is about right. When the edge of the scraper is turned over in this way, the edge of the work bench forms a guide for the hand which holds the "steel," so the operator has the assurance that the edge of the scraper is turned over to a regular and certain angle. The proper amount of pressure to be used can be ascertained only by trial; some scrapers require more force than others on account of their difference in temper. A coarsely turned edge only works in fits and starts, and is apt to leave the work with a lumpy finish; therefore, when turning the edge, do not give the steel too much angle. After trueing and setting, the edge should be as keen as a razor. Many fail to get a good edge on the scraper through trying to turn over the edge when holding the scraper edge upwards on the bench.

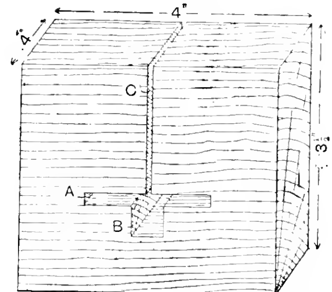


FIG 1

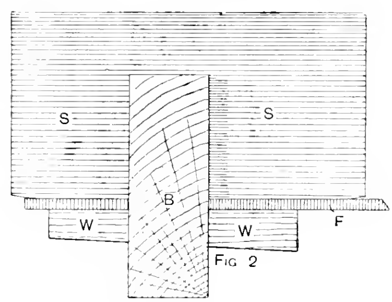
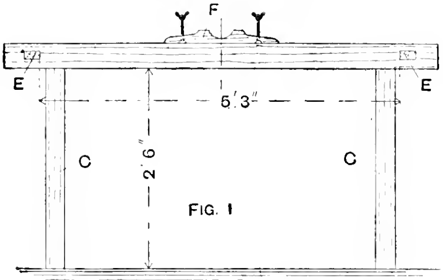


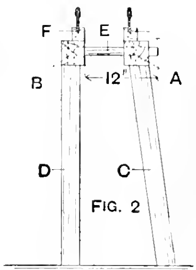
FIG 2

Sharpening a Cabinet-maker's Steel Scraper.

Repolishing a Bath Top.—Scrub off the polish with strong washing soda, using a little powdered pumice stone or Bath brick to assist. When dry, smooth down with glasspaper. Bath tops are usually French polished with a trace of red in the polish to make them look rich in tone. If this is done, and the surface left perfectly free from grease, and afterwards given an even coat of best quality oil varnish as used by house painters, a good wearing surface will be secured. If unable to French polish, fairly good results may be obtained by the use of a combined mahogany stain and varnish, as sold at paint stores, but a good quality oil varnish must be used afterwards.

Wheelwright's Horse for Mortising Wheel Naves.—The horse shown in Figs. 1 and 2 is to be preferred to the pit for light work. It stands close against a wall, preferably under a window; the larger parts can be made of deal. It is very light, and can easily be removed if desired. In Fig. 2, A shows the front of top of wheel horse and B the back, each being 4 in. square; C D are the legs, 3 in. square; E E are two pieces connecting front and back of horse together, $2\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in. thick. These are driven tightly into a mortise about halfway through B and pegged or screwed; the other ends fit fairly tight in a mortise going right through A, so that the whole front of horse, with legs, can be knocked backwards and forwards to accommodate hubs of different lengths. Two pieces F F, 2 in. square and 19 in. long with $\frac{3}{4}$-in. bolts, are nailed or screwed on top of wheel horse and hollowed out on top for nave to rest in. To strike a curve on front piece, open the compasses $2\frac{1}{2}$ in., and for back piece 3 in. The nave is fixed with pieces of iron about 1 in. wide and $\frac{3}{8}$ in. thick, dropping loosely over the bolts and spanning the nave at front and back, which they are bent to fit. A frame for a pit for making very heavy wheels would have to be a fixture; the front might be 7 in. wide in the centre, and taper on the inside to $3\frac{1}{2}$ in. at ends, thus forming a bow piece to allow for the dish of the wheel. The timber for making the pit frame shown in plan, Fig. 3, should be 3 in. or 4 in. thick, the pit being 2 ft. 6 in. deep. The four mortises G are $1\frac{5}{8}$ in. square, and the ground should be cleared away underneath them so that the pieces shaped like Fig. 4 (which are about 22 in. long, $1\frac{5}{8}$ in. thick, and 4 in. wide at the top) may be knocked back from below. The inner surfaces of these holding pieces should be shaved out on the bevel, so that when driven in they come into close contact with the sides and top of the hub, thus holding it in place. These pieces (Fig. 4) take the place of the four thumbscrew bolts of the wheel horse.





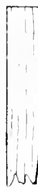


FIG. 4

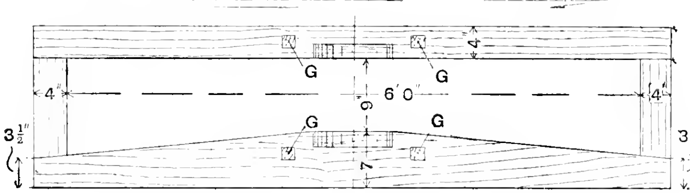


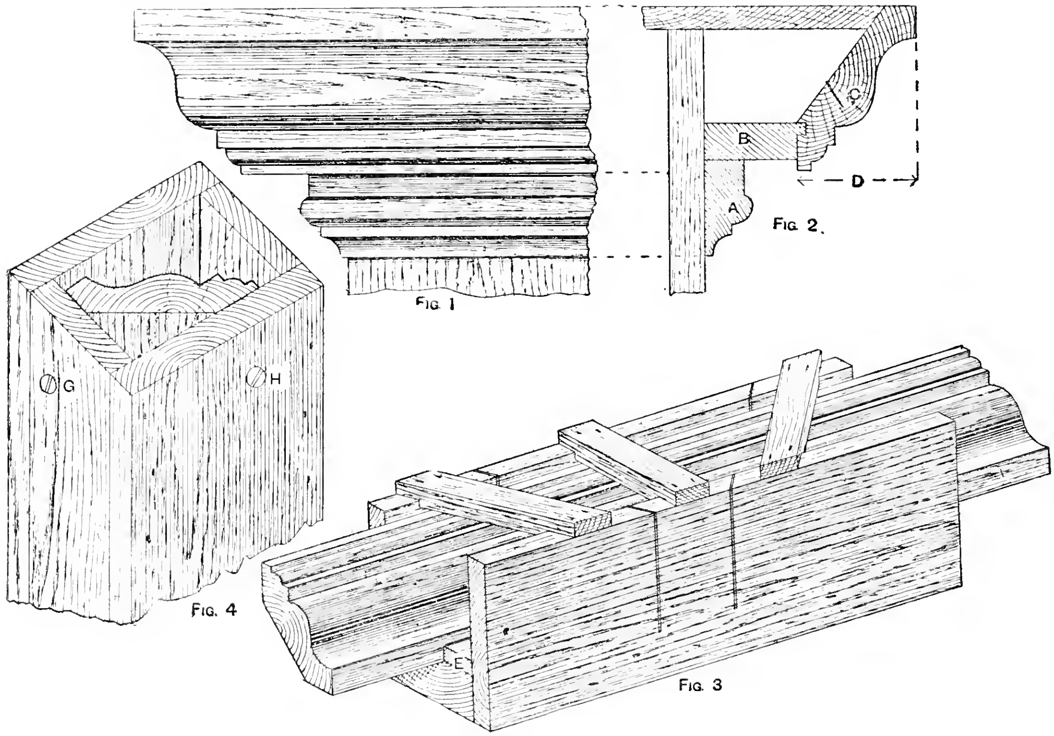
FIG. 3

Wheelwright's Horse for Mortising Wheel Naves.

Fitting a New Hairspring to a Watch.—It is first necessary to know how many beats per hour the balance is required to make. This varies according to the kind of watch. A Geneva or an American watch will beat 18,000 per hour; an English watch may beat 14,400, 16,200, 18,000, or some number between. In an English lever, if the fourth wheel has ten times as many teeth as the 'scape pinion has leaves, the train is 18,000; if nine times as many, it is 16,200; if eight times as many, it is 14,400. A watch with an 18,000 train beats 150 double vibrations per minute, and so on. The number of beats per minute of a watch balance when keeping correct time may be anything between 240 and 300. Watch trains are calculated as so many beats per hour. Thus, a watch beating 240 per minute is said to have a 14,400 train, and one beating 300 per minute has an 18,000 train. To ascertain the train of any watch, multiply together the numbers of the teeth in the centre, third, fourth, and 'scape wheels. Also multiply together the numbers of the leaves of the third, fourth, and 'scape pinions. Divide the first product by half of the second product, and the result is the number of beats per hour. Thus, centre wheel has 60 teeth; third wheel, 60; fourth wheel, 54; 'scape wheel, 13; third pinion, 8; fourth pinion, 6; 'scape pinion, 6. Then $60 \times 60 \times 54 \times 13 = 2,527,200$; and $8 \times 6 \times 6 = 288$. Therefore, the train $= 2,527,200 \div \frac{288}{2} = 17,550$. Select a hairspring of about the required diameter to suit the regulator pins, or a little larger, and lay it in position on the balance, pushing the brass hairspring collet down tightly upon it to hold it temporarily in position. Then hold the outer end of the spring in a pair of tweezers, and lift up the balance, just allowing the lower pivot to rest upon a watch glass. In this position, give it a rotary motion, as in the watch, holding it as steady as possible. When once started, the balance will continue to vibrate backwards and forwards for more than a minute. Have at hand a watch with a seconds hand, and carefully count the double vibrations in a minute, or, for a preliminary trial, in twenty or thirty seconds. If the trial spring is too slow, try a stronger one; if too fast, try a weaker spring. Be careful to hold the spring in the tweezers at the point where it must be pinned into its stud, as a spring that is too large for the watch must have several complete turns broken off before using, and in such a case must be held in the tweezers for counting several turns from the outside end. By repeated trials, select a spring that, when held at the required diameter, counts the correct number in a full minute. To pin it into its collet, put the collet on a broach and hold in the hand; cut out the inner coils of the spring until the collet will easily pass through; then bend the inner end sharply inwards to pin in the collet. To cut out the centre, lay the spring on a watch glass and, holding the inner coil with a fine pair of tweezers, break off about one-third of a turn at a time until it is correct. When properly cut out, and the end bent inwards, pass the hairspring over the broach upon which the collet was placed, and insert the bent-in end for pinning. File up a smooth brass pin to fit, flat it on one side (to go against the spring), try it in the hole before cutting off, and half cut it through with a knife; then insert it, and break off, afterwards pushing it home with the tweezers. Then see that the spring is flat as it stands upon the broach, and revolve the broach in the fingers to test it. If flat, take it off the broach, lay it on a watch glass, and see that it is true to centre—that is, that the collet occupies the exact centre of the spring, and that the spring starts away from the collet freely, and does not "hug" it. Then put it on the balance, and again count it for a full minute, trying it repeatedly until a point is found at which, when held, it counts *one beat* per minute too slow. This is the point at which to pin it in its stud. Then try in the watch, and if too slow, as it will be a trifle, shorten it until correct. It is always best to pin them in a little slow at first, and shorten till right, as, if the spring is once made too short, it cannot again be lengthened. When finished and in the watch, be careful to see that the spring lies quite flat, and is free of the balance arms and the balance cock; that its outer coil passes freely between the curb pins of the regulator, and plays between them nicely; and that the second coil does not touch the stud or the inner curb pin, and in a Geneva watch be careful that the outer coil never touches the centre wheel.

Stain and Varnish for Towel Rail. — Towel rails are usually finished in imitation pine or mahogany. For pine, mix a small quantity of raw sienna with stale beer or vinegar; apply with a brush, rubbing well into all quirks, and wipe off the surplus with clean rag. For mahogany, use burnt sienna. When dry, rub smooth with coarse rag or fine glasspaper. Then coat several times with spirit varnish applied with a camel-hair brush. A more intense red may be gained by adding one pennyworth of Bismarck brown to each pint of varnish. A suitable varnish consists of methylated spirit, 1 pt.; shellac, 4 oz.; resin, 2 oz.; and gum sandarach, 2 oz. Dissolve in gentle heat, and carefully strain.

Mitring a Cornice Moulding.—The method of mitring the cornice moulding shown by Fig. 1, when the cornice is built up as shown by the section (Fig. 2), should present little difficulty in respect of the members A and B. To keep the moulding in position whilst cutting the mitre of C, place a strip of wood E in the mitre box (Fig. 3); the distance from the edge of this to the back of the box must be equal to D (Fig. 2). For ordinary purposes, mitres made direct from the saw without shooting are suitable; the saw must have but little "set," and the mitre box must be true. Should easing be necessary, use an iron face smoothing plane set fine. In more important work where the mitres have to be shot, a screw mitre shoot will be found very useful. A simple form of shoot can be made by nailing together four pieces of prepared wood and carefully mitring the end, as shown at Fig. 4, in which the moulding can be firmly held while it is being shot by a couple or more screws going through the box into the back and top of the moulding, as indicated at G and H (Fig. 4).



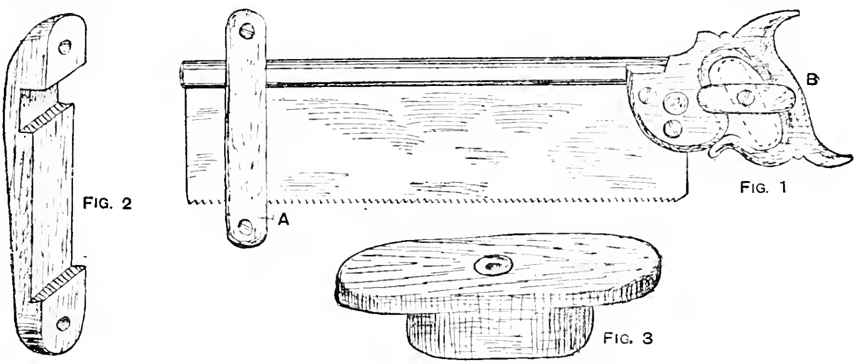
Mitring a Cornice Moulding.

Making Indiarubber Tubing. — There are two methods of making rubber tubing. The pure rubber is treated with carbon bisulphide or benzine to form a dough, which is rolled out into thin sheets and then cut into strips. A strip is rolled round a cylindrical mandrel the diameter of the tube required, the superfluous edges are cut straight along, and the freshly cut edges touched with rubber solution and pressed together. The rubber is now cured either by soaking for the requisite time in a solution of sulphur chloride in carbon bisulphide, or by heating in a mixture of French chalk and sulphur to a temperature of about 140° C. The mandrel can afterwards be withdrawn. Wired tubing is made in the same way, the wire serving in place of the mandrel. Some tubing is made by kneading between steam-heated rollers the uncured rubber with sulphur and inert materials, such as zinc oxide, French chalk, etc., and forcing it through a hole in a die in which is a plug the same diameter as the tube. The rubber tube is drawn away as fast as it is formed, then placed in French chalk and heated to 140° F. The core of catheters and similar things is an iron wire, which is withdrawn after curing.

Making Photographic Carbon Tissue. — Carbon tissue may be purchased either sensitised or unsensitised. Sensitised carbon tissue will keep for a fortnight, under pressure; unsensitised tissue will keep indefinitely. To sensitise the tissue, immerse it in a solution of bichromate of potash, and let it dry squeegeed in close contact with glass. This operation is conveniently performed at night, when, if the room is kept fairly dark, the glasses may be placed in the rack over the kitchen fire; in the morning they will be dry. Care must be taken to dry the tissues away from gas or oil fumes, as these make the tissue insoluble. Many good authorities, however, consider that better results are obtained when the bichromate is mixed with the gelatine before coating the paper. The following is Burton's procedure:—Cover 4 oz. of Nelson's opaque or other soluble gelatine with 15 oz. of water, and allow it to swell for an hour or so; then thoroughly dissolve by placing the jar containing it in hot water. Dissolve $1\frac{1}{2}$ oz. of loaf sugar in 2 oz. of water, and add to the dissolved gelatine. Next dissolve $\frac{1}{4}$ oz. of potassium bichromate in 3 oz. of water, and add to it sufficient ammonia to give it a decided odour; then mix with the gelatine. The favourite pigment is Chinese ink, but any pigment in a very fine state of division is suitable; it should be broken up, and made into a stiff paste with water. Mix some of this pigment thoroughly with the gelatine in small quantities, stirring vigorously, until more pigment has been added than is necessary to render quite opaque a thin film spread on paper. The support must be a good tough paper that will stand rough handling when wet. Over the top of a trough is then fixed a large glass rod or tube. Two sheets of paper are placed back to back, and, one end being brought under the rod, the solution is poured out until it half covers the rod; by gently drawing the paper round the roller the two outside faces are coated. Hang up to dry, and the paper is then ready for use.

Making Watch Hairsprings.—The operation of making watch hairsprings requires special skill. In making by hand, flat wire is fastened at one end to the arbor of a winder not unlike a mainspring winding tool and wound up quite tight, and kept flat by a brass guide on each side like a bobbin. When wound singly and released, the spring will open out a trifle only, and the finished spring is a "close-coiled" one. But when two or three wires are wound up one over the other, the results are more open in the coils. The best hairsprings are afterwards fire-hardened and tempered, but common ones are left soft. They are hardened by being heated to redness in a box specially made to exclude the air, and then plunged into oil or water. They are tempered by being heated on a metal plate until a slip of bright steel placed beside them turns to a full blue. They are then polished by means of rouge and oil on a peg or wood polisher (this is very delicate work), and afterwards "blued" by heat on a metal plate over a lamp flame. These fire-hardened hairsprings are expensive, but are always used in the best watches.

Fastening Tenon Saw to Lid of Tool Chest.—A simple method of fixing a tenon saw on the lid of a tool chest is to use a wooden clip, as shown at A (Fig. 1), which holds the end of the saw. The handle can be fastened by a button, as shown at B. When the button is moved to the position shown by the dotted lines, it will allow of the saw being taken out. Figs. 2 and 3 are enlarged sketches of the clip and button respectively.



Fastening Tenon Saw to Lid of Tool Chest.

Recipe for Dead Black Waterproof Ticket Ink.—Take ivory black or any dry colour and grind (on a slab with a muller) in japan gold size to the consistency of honey (the proportions cannot be given, as one colour will absorb more size than another colour). Now spread the colour on a piece of stout blotting paper, and let it remain for about an hour; this will extract the grease from the gold size. Collect the colour in a pot and thin with benzine, as the latter evaporates quicker than turps, leaving a better flat.

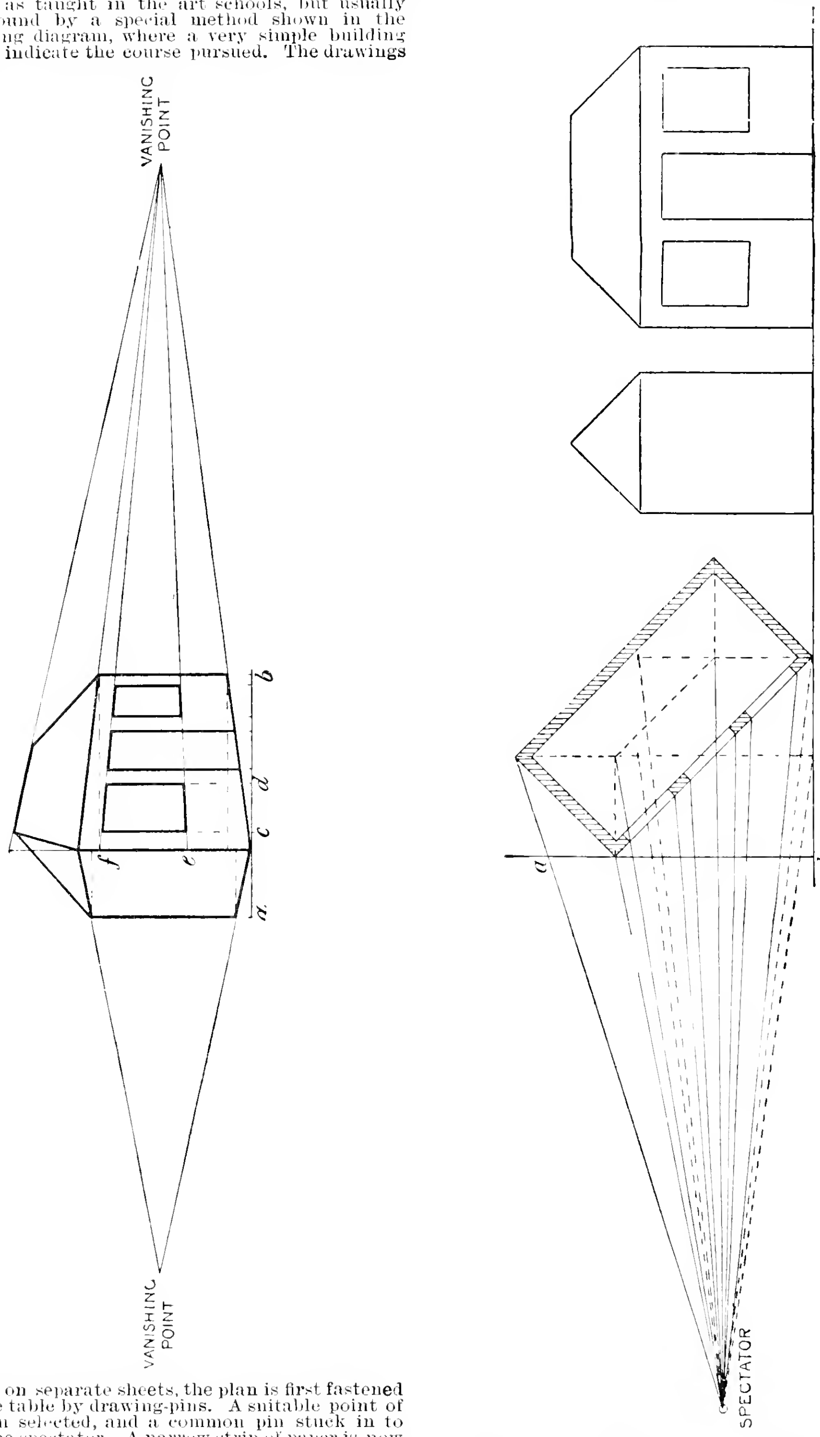
Preparing Scenery for a Diorama.—The kind of cloth used for dioramas is called union; it is made in various sizes, and requires no preparation to receive the colours. The subject to be represented is first carefully drawn in outline with a pencil. Then mix some vandyke brown with hot double size, and with a fine brush go over the pencilled outline. When thoroughly dry, the painting of the picture may be proceeded with. Jelly size is the medium, about 1 qt. of water to a pound of size. Only transparent colours should be used, such as azure blue, celestial blue, indigo blue, damp lake, brown lake, Dutch pink, raw sienna, burnt sienna, Indian yellow, Indian red, vandyke brown, ivory black, blue or sky colour. Break up some whiting and cover with water. Take as much azure blue as is required for the sky colour, and make it into a paste with water, adding just enough whiting to make the blue flow evenly; the colour should be semi-transparent. Cover the whole of the picture with this colour, commencing at the top and working downwards. As the work proceeds the colour should be thinned with the medium, so that there may be a gradual change of tint from dark to light. All illuminated parts must be thinly covered. When this is dry, give the other portions of the picture their local colouring, and finish off. If the other side of the picture is to represent moonlight, draw the moon with a fine line and slightly tint it with appropriate colour. For the dark parts of the sky, use celestial blue; for the dark clouds, indigo; and for very dark clouds, sadden with black. All trees and foliage should be treated in the same way; the buildings, etc., should be covered with a deepened local colour, especially in the dark parts and shadows. Windows and illuminated parts should be covered with Indian yellow for yellow lights, and with lakes for red lights such as a fire. The dioramic change is made by gradually turning down the light in front and turning it up at the back. The stronger the light the better will be the effect.

Making Cyanide of Potassium.—Prussian blue, ferrocyanide of potassium (yellow prussiate), and cyanide of potash are now recovered by the Gas Light & Coke Co. from the purifying materials used. There are two methods of recovering the cyanogen compounds: the first by absorption in the scrubber, the second by absorption in the oxide purifiers. In the first method a scrubber is used containing soda or potash and some suspended oxide or hydrate of iron; the cyanogen in the gas combines with the iron and alkali to form ferrocyanide. If the iron is in excess the compound is insoluble (probably as Prussian blue), but if the iron is not in excess, then the compound is soluble. After a certain period the liquid is run off for concentration. In the second method the cyanogen is fixed in the oxide of iron purifiers as Prussian blue (ferric ferrocyanide). By leaving one oxide purifier as No. 1 in the series long after it has become saturated with sulphuretted hydrogen as much as 8 or 10 per cent. of Prussian blue has been obtained from it. The oxide of iron is exposed to air in the usual way to revivify, and the sulphur extracted by carbon bisulphide in closed vessels; the sulphur is recovered, and the carbon bisulphide used over and over again. The spent oxide is boiled with lime and water, when the Prussian blue is decomposed and ferrocyanide of lime is produced. The clear solution is drawn off acidified, and a per and proto salt of iron added yielding a pure Prussian blue, which is allowed to settle, washed, collected in bags, filter pressed, and dried. From this pure ferrocyanide of potash is produced by boiling with the calculated equivalent of caustic potash. Cyanide of potash is formed by fusing Prussian blue or ferrocyanide of potash with the right proportion of carbonate of potash.

Sizing and Varnishing Wall-paper.—To size and varnish the paper of a hall and staircase, dissolve 7 lb. of size in 3 gal. of boiling water. When cold it will be of the consistency of a weak jelly. Apply this to the paper with a double-knot distemper brush, being careful to go over every bit of the paper. Twelve hours after, apply a second coat of size. Twenty-four hours after the second coat has been applied the paper will be ready for varnishing. A good paper varnish may be made by well mixing ½ gal. of pale oak varnish, ¼ gal. of turpentine, and ½ pt. of raw oil. If the weather is frosty, the staircase and hall should be heated to about 60° F. If this is not practicable, wait until the frost disappears. Spread the varnish with a hog's-hair varnish brush, commencing at the top, and working evenly downwards. A second coat of varnish six months after the first has been applied would make a first-class job.

Preventing Oxidation of Molten Lead.—Strew powdered charcoal over the surface of the metal; or add borax, which will fuse and form a layer upon the lead, thus excluding the atmosphere. The brown powder is largely oxide of lead; it may be reduced by mixing with finely powdered charcoal and a little borax and raising to a red heat; from it the lead which it contains can thus be recovered.

Architects' Perspective Drawings.—The perspective drawings prepared by architects sometimes have the principal lines put in by the rules of geometrical perspective as taught in the art schools, but usually they are found by a special method shown in the accompanying diagram, where a very simple building is chosen to indicate the course pursued. The drawings being often on separate sheets, the plan is first fastened down on the table by drawing-pins. A suitable point of view is then selected, and a common pin stuck in to represent the spectator. A narrow strip of paper is now fixed by two drawing-pins, and a line ruled upon it in the position chosen for the transparent plane, or picture plane, which should touch the nearest angle of the building, and a straight-edge is used to mark lines across the picture plane from the pin to all the chief angles of the plan, as on line *a b*, writing the names against the chief ones so as to know one from the other. A line representing the ground line is then drawn below the position of spectator, as if the view were a section, vertical lines drawn from the corners of the building, and the heights of the angles set off above the ground line. Dotted lines are now drawn from the extremities of these to the pin, cutting the picture plane in the



Architects' Perspective Drawings.

points marked. Now, for the perspective, take a clean sheet of paper, and fasten it down on a drawing-board, pin the strip of paper *a b* horizontal near the bottom edge, and project vertical lines from the points which represent the angles of the building. Decide where the bottom of the nearest angle in the perspective shall be, and above it set off the heights where the dotted lines crossed the picture plane, measured from *b*, and from them draw horizontal lines to intersect vertical lines drawn from *a b*. Join the intersections, and the two visible sides of the house will be obtained. Produce these to intersect on each side, and the two vanishing points will be found. For the remainder draw vertical lines from any given points on *a b*, such as *c d*, set up the height of the parts on the front angle of the perspective, such as *e f*, place a straight-edge from these points to line with the vanishing point, and the intersection with the vertical lines will give the required perspective. Geometrical perspective is useful as giving a scientific foundation and reason for the appearances of objects of all kinds when viewed naturally by the eye. Ordinary drawings of buildings and details are merely conventional representations, and although they may be looked upon as flat models, and are most useful, they do not represent things as they are seen. Architects' perspective is an empirical or "rule of thumb" method suited to the circumstances, but not available as a basis for the general study of the subject.

Medicine Cupboard.—Fig. 1 shows a front elevation and Fig. 2 a side elevation. It is 2 ft. long and 17 in. wide, and is fastened to the wall by four mirror plates, one at each corner. The four shelves are let into the ends about $\frac{3}{16}$ in. by sawing two gates and cutting out with a narrow chisel. The doors have imitation panels made by mitreing strips, chamfered at the edges, of a plain door 1 in. by $\frac{1}{4}$ in. The piece sawn out of the top is fastened to the edge of the top shelf. The bottom shelf is rounded at the corners to bring it to the width of the end, as it is narrow where the bottom shelf goes. The ends are of $\frac{1}{2}$-in. wood, the shelves of $\frac{3}{8}$-in. wood, doors of $\frac{1}{4}$-in. or $\frac{3}{8}$-in., and the back of $\frac{3}{8}$-in. wood. A button on the partition will do instead of locks.

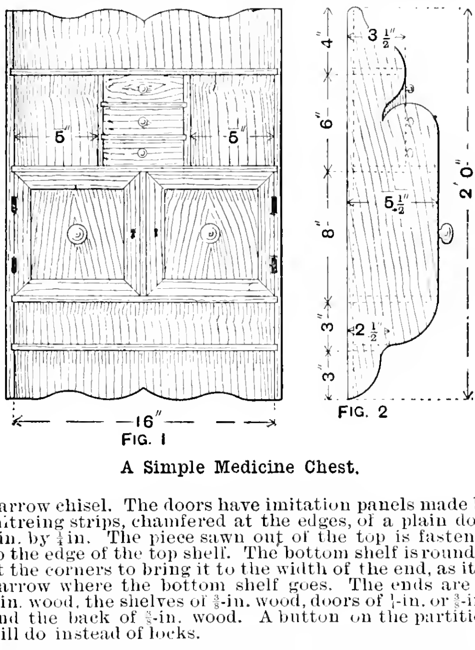


FIG. 1 FIG. 2

A Simple Medicine Chest.

Waterproofing Van Sheets.—A waterproof paint for van sheets may be made by boiling together, at a temperature of 500° F. for four or five hours, $1\frac{1}{2}$ gal. of linseed oil, 2 oz. of litharge, 2 oz. of umber, and just sufficient vegetable black to colour it. Another paint is made from 1 gal. of boiled linseed oil, $\frac{1}{2}$ pt. of japanners' gold size, 1 lb. of vegetable black, and 1 lb. of best patent driers. The sheet should be laid upon a table and painted with either of the above paints, dried in the open air for several days, then again painted and dried.

Disinfecting Books.—If the book to be disinfected is not of much value, burn it. A valuable book may have each page dipped in a solution of bichloride of mercury, blotted and dried, the covers removed and burnt, and the book rebound. Or the book may be passed through a hot-air disinfector, the pages being opened so as to allow the hot air to pass between them; and probably the book will have to be rebound. A steam disinfector is equally effective, but the book will be more damaged than by hot air, and the covers will be completely ruined, making rebinding a necessity. At Sheffield, a disinfecting apparatus is in use in connection with the free library, the books being placed in a closed chamber in which carbolic acid is vaporised by heat, which it is claimed makes the carbolic acid more potent and active; the vaporisation takes place at 80° F., the vapour being raised to about 200° F., and the books being subjected to this process for about fifteen minutes. It is also stated that books can be disinfected in fifteen minutes in a closed space simply by formaldehyde vapour (or vapour of commercial formalin) by using 1 cub. centimetre of formalin to 300 cub. centimetres, or less, of air. The books may be placed on their ends, but the better plan is to hang them up; the covers are opened out until they touch each other, and are fastened together, being suspended from the fastener; by this means all the leaves are slightly separated, and free access for the hot air, steam, or disinfecting vapour permitted. They should never be placed flat. These methods are equally suitable for typhoid germs as for tuberculosis.

Reviving Polish on Pianos.—Take equal parts of lime water, raw linseed oil, and turps. Well shake the lime water and oil till a cream is formed, then add the turps. Apply liberally with wadding, and wipe off with rag. Clear out all greasiness, and bring up the polish by means of a clean rag made fairly moist—not wet—with methylated spirit. Repeat if required. Should there be any peeling off by reason of the paste already on, wash off with 2 gal. of warm water, to which has been added a teacupful of common washing soda.

Bed-rest for Invalid.—A simple form of back-rest suitable for an invalid when sitting up in bed is shown in the accompanying sketch. For its construction good red deal, birch, or mahogany may be used. Make three frames similar to Fig. 1, the outer edges being rounded. These three frames are hinged together as shown at Fig. 2, the back frame having a slanting edge to fit into the notches of the bottom frame. A pair of iron or brass hinged stays, fixed at the sides, will prevent the sliding back from slipping.

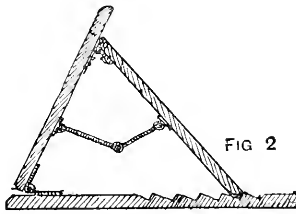


FIG 2

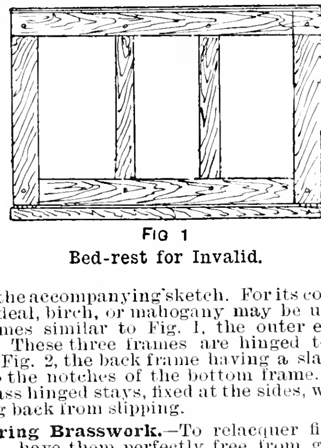


FIG 1

Bed-rest for Invalid.

Lacquering Brasswork.—To relacquer fire brasses, curbs, etc., have them perfectly free from grease, and heat them on a hot plate of some kind, and when hot enough apply the gold lacquer with a camel-hair brush; then place them on the hot plate again for a short time. Take the articles off and allow to cool; do not touch them while hot with the fingers.

Polishing Teak to Resemble Rosewood.—To stain and polish teak to represent rosewood, dissolve one pennyworth of Bismarck brown in 1 pt. of hot vinegar and water (equal parts). With this, brush over the article once or twice. When dry, wipe over with "red oil," which is made by steeping 2 oz. of alkanet root in $\frac{1}{2}$ pt. of raw linseed oil. The work is then ready for polishing. As teak is a hungry wood, to gain good results a grain filler should be used. Mix finely crushed dry whiting into a creamy paste with turps, colouring it to match the wood by adding venetian red and vegetable black or lampblack. Rub well in in order to fill up the grain. Wipe off clean, leaving the surface of the wood free from paste, and polish in the usual way, adding Bismarck to the polish to give a reddish tinge; if a darker tone is desired, a trace of black may be added.

Erasing and Re-engraving Initials on Watch Case.—To erase initials from a watch case is a delicate job. If the letters are in the centre of an otherwise plain case, take a fine flat file (costing about 4d. at a jewellers' material dealer), and, with short, firm strokes, file out the letters. Then go over the surface with a piece of snakestone or Tam-o'-Shanter hone, and finish with putty powder on a piece of soft leather. If the letters are in a small shield, the tendency is to damage the outside work, which would require to be re-cut. With a small riffler, or bent file with a flat surface, file out the letters, dress with snakestone fashioned to a point, and finish as described above. If new initials are required, first draw them in pencil, and scratch them on with a point or etching needle. Then whet up a graver at moderately sharp angles, outline lightly, put in the thickening cuts, relieve the whole with light and graceful sprigged work, and then clean up.

Combined Jewel, Glove, and Handkerchief Case.—A case made in the form of Fig. 1 will be suitable for holding jewels, gloves, and handkerchiefs. It is 14 in. by 8 in. by 9 in. deep, and contains two drawers, one to receive handkerchiefs and one to receive gloves. The upper part is fitted with a tray to lift out; this is to hold jewellery. Figs. 3 and 4 are plans of the two drawers. Fig. 2 is a plan of the tray; the centre part A is movable, and is arranged to hold a watch, the latter lying on a cushion formed on a piece of $\frac{3}{16}$-in. wood. The part at the back is left open to allow the watch chain to fall into the drawer or box underneath the cushion. The back part of the tray is fitted with four compartments to receive trinkets, etc.; the side parts marked B, with ribbon loops, are for pins, brooches, etc.: the sides marked C are slotted to receive rings, etc. The whole of the interior is covered with velvet plush, the inside of cover of the case is fitted with a bevelled mirror, and the sides are lined with plush, and buttoned. If a smaller case is required, make a box in the ordinary manner, and fit it with a tray as Fig. 2, omitting a compartment in length. To line the drawers of the glove box rebate the inner upper edge of the drawers as shown in the accompanying sketch, and after fixing the lining A, fix in the bead B. T is the top edge of the division and F the front of the box. The divisions should stand lower than the upper edge, and in covering, the lining should be stretched over the top edge, the raw edges being carried to the bottom. Glue, if used thick, will not spoil the pile; if used in a thin state, the glue will percolate through the foundation, and so spoil the velvet.

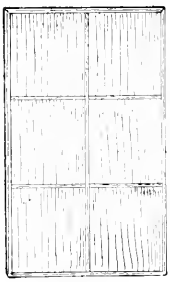


Fig 4

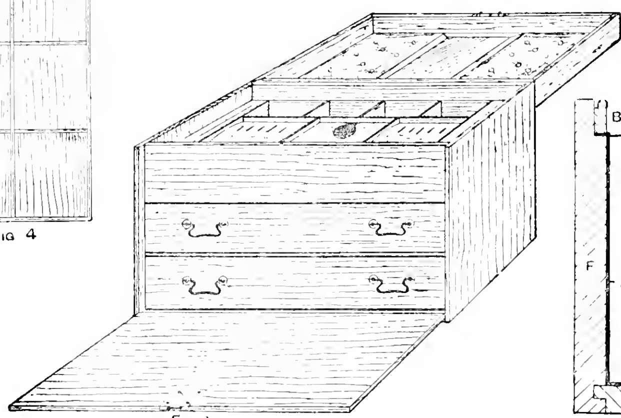


Fig. 1

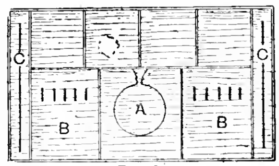
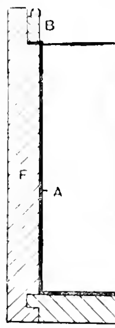


Fig. 2



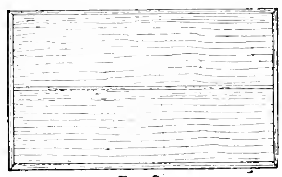


Fig. 3

Combined Jewel, Glove, and Handkerchief Case.

Hints on Printing Blue Photographs.—The details of the picture should be fully out, and the dark parts should have a bronzed appearance. Care is required to prevent the blue becoming less intense, and therefore the white lines not showing up so much. A print too much exposed appears weak, but the same occurs with too little exposure. The ferricyanide used should be as pure as possible. It is affected by air and light, which may change it into ferrocyanide. The first forms a blue precipitate, and the second a white. Crystals of ferricyanide should therefore be rinsed before use to rid them of the changed outside covering. The first washing water should be acidulated with hydrochloric or citric acid. This tends to improve and retain the brightness of the image, by dissolving out the remaining iron, and preventing the deposition of a white precipitate over the blue. It is very desirable that the paper should not in any case be washed for a lengthy period.

Tinning Inside Copper Pipes and Brasswork.—For tinning any metal it is first necessary to clean it from dirt and sand and remove the surface which is oxidised or tarnished. This surface is removed by pickling the metals for a few hours in clean water containing a small quantity of sulphuric acid. The metals are then dipped in chloride of zinc, and afterwards laid in a bath of molten tin, out of which they are taken and held up for the surplus tin to drain off. It is doubtful whether this process is entirely satisfactory for artificial mineral waters, as the so-called tinned surface partakes more of the nature of an alloy of tin and zinc. Unless the proper appliances are at hand, it is cheaper and better to buy the copper pipes already tinned. It is also probable that white-metal cocks or taps would answer equally as well as those made of brass, which would have to be tinned before being ground in.

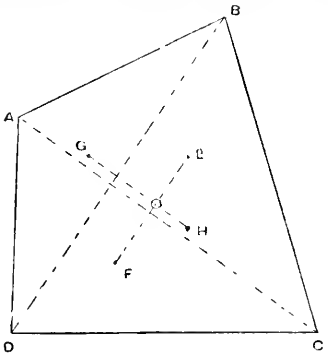
Contents of Tapering Vessels.—A gallon of water occupies 277·27 cub. in., and the capacity of the frustum of a cone can be obtained by adding to the sum of the areas of the two ends the square root of their product and then multiplying by one-third the vertical height. The contents will be in cubic inches if the areas and heights are measured in square inches and inches respectively. Of course, there are many varieties of tapering vessels that will hold 1 gal., but, assuming that the diameters are $3\frac{5}{8}$ in. and $4\frac{1}{4}$ in. at bottom and top of the vessel respectively, the height can be determined as follows:—The areas of the two ends will be $3\frac{5}{8} \times 3\frac{5}{8} \times {\cdot}7854 = 10{\cdot}3$ sq. in., and $4\frac{1}{4} \times 4\frac{1}{4} \times {\cdot}7854 = 14{\cdot}2$ sq. in. respectively; the product of these is about 144, its square root being twelve. The sum of the ends, etc., is therefore $10{\cdot}3 + 14{\cdot}2 + 12 = 36{\cdot}5$, so that the height should be $3 \times \frac{277{\cdot}27}{36{\cdot}5} = 22{\cdot}7$ in. (say).

Etching on Copper.—A copper plate is polished, and fixed in a mixture of resin and beeswax by warming the wax and laying the copper plate on. All grease is removed with whiting, the surface of the copper coated with fine wax, and the pattern drawn with a fine etching needle passing through the wax to the copper. Nitric acid is then applied to the surface; this eats into the copper plate where pricked with the etching needle, the wax preventing the acid from biting in places not required. When sufficiently bitten in, the plate is removed, the wax warmed and pulled carefully off, and the plate cleaned with turpentine.

Making Night-lights.—Night-lights are made by melting the material and pouring it into metal moulds in which the wicks have been previously placed. The commoner night-lights are made from paraffin wax, whilst the better ones are made from stearin (the fatty acids which are obtained from tallow or palm oil by saponification and pressure); or from composite, a mixture of paraffin wax or cerasin with stearin (*glyceryl tristearate*).

Copying a Mounted Photograph.—The print should be copied in contact with glass. Presuming the print is upon an ordinary mount (that is, not set back in a cut-out mount), place it in a frame containing a perfectly clear sheet of glass, and press into close contact. Set up the frame facing a full light, care being taken to avoid reflection by covering up objects that are reflected in the shadows of the picture. If a studio is not available, the copying should be done out of doors in full sunlight, in which case it may be possible to avoid grain without copying under glass. Slow plates are the most suitable, but much depends upon the degree of contrast in the print, the printing process to be used, etc. For example, if the copy is very hard, and the picture is to be printed upon P.O.P., use a quick plate and the usual developer. If, on the other hand, the copy is flat and wanting in contrast, and the negative is for printing in carbon or for reproduction, use a process plate and hydroquinone developer.

Position of Mast in Canoe.—The centre of effort of a single lug-sail should be about 3 in. ahead of the centre of lateral resistance of the immersed portion of the canoe's hull; the correct position of the mast will therefore depend on the position of the centre board, if any, or the shape of the keel, neither of which is given. The centre of any triangle's area is the point at one-third of the line from the centre of any side to the opposite angle. Hence, if the sail be divided by line A C (see sketch) the points E and F will be the centres of triangles A B C and A C D respectively. Join these points by line E F. Again divide the sail by the line B D, find G and H the centres of triangles A B D and B C D; join G and H, which line intersects E F at ⊙, the "centre of effort" of the sail. To ascertain the centre of resistance,



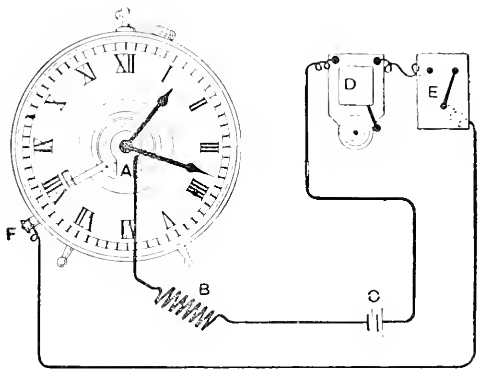
Position of Mast in Canoe.

let down the centre board, place the rudder amidships, and let the crew on board hold one end of a string in such a position that when the other end is steadily pulled by a second person, the canoe will approach the latter, remaining at right angles to the string. Mark this position, and step the mast in order that the sail's centre may be 3 in. or 4 in. ahead of it measured horizontally. The rudder stock must not extend below the keel, but the drag may be curved to 4 in. below it and extending aft to 10 in. A nearly vertical stern-post is advisable.

Power from Waterfalls, Tides, etc.—The different methods by which water can be made to perform mechanical work are: First, by its weight; second, by shock, as when a stream of water impinges at right angles on a moving surface; third, by action or impulse, as when an unconfined stream of water meets a moving surface, the relative velocity having no portion at right angles to the surface, but gliding along and ultimately leaving the surface; fourth, by reaction, as when a stream of water enters, flows through, and ultimately leaves a moving pipe or channel, which it completely fills; and fifth, by a combination of two or more of the above methods of action. The classification of the motors may be as follows: (*a*) Water wheels (the water acting on the outside of the wheel) are either undershot, breast, or overshot wheels; (*b*) turbines (an arrangement where the water acts through the inside of the wheel) are either on the axial or the radial flow system, and may work either by reaction and impulse combined or by pure impulse alone. Water power is useful for any industry requiring slow-moving, regular power, such as corn-grinding, ore-crushing, chemical mixing, etc. Tide motors may be on two systems: in the former, the tidal waters rush through a small opening into a reservoir, actuating a turbine which is fixed in the opening, and the ebb water rushes out through another opening (the first opening being closed by a penstock or shutter) actuating another turbine. The cost of the reservoir, which is practically a tidal dock, is very great. In the other system, a series of wooden gates hanging from a frame are set in motion by the rise and fall of the waves, and their motion is conveyed by cranks and rods to an engine. Tidal motors, especially the latter form, are only available for purposes not requiring regularity, such as pumping water for keeping a reservoir replenished.

Rubber Solution for Patching Mackintosh.—Rubber solution must be made from indiarubber which has not been vulcanised; Para rubber is considered best for the purpose. The rubber should be cut into thin shavings with a very sharp, wet knife. The shavings may be dried, then placed in a dry, wide-mouthed bottle, and covered with benzene (coal-tar naphtha) or carbon bisulphide. Benzene is preferable, as it does not smell quite so strong as carbon bisulphide. The bottle should be tightly corked, placed in a warm place, shaken from time to time, and more solvent added as the rubber swells. One ounce by weight of rubber will take from 15 oz. to 20 oz. by measure of the benzene. This solution will be found suitable for patching a mackintosh or for use in places where rain penetrates, but as a dressing for re-waterproofing it will not stand.

Electric Alarm Device for a Clock.—The diagram below shows how to attach an electric bell to a clock, the bell to ring at any given time. A is an alarm device cemented to the face of the clock. The flexible wire at B is connected to the battery at C, and thence to the bell D and make and break switch E. The terminal connected to the pivot of the switch may be connected



Electric Alarm Device for a Clock.

to a terminal F fastened on the clock case. Thus a complete circuit is formed with the whole of the apparatus in series.

Polishing Tarnished Copper. — The quickest and cheapest method of polishing tarnished copper is to buff up the article on a polishing machine; if this is impracticable, it may be polished by hand. To do this, mix some fine flour emery with sweet oil until a thin paste is formed, and, using a piece of house flannel as a pad, scour the tarnished surface with the paste until the surface is quite clean. Wipe off the oil from the copper, and with a dry piece of flannel dust the copper over with crocus powder, and polish with this until quite bright.

Painting Canvas Canoe.—Both sides of the canvas material of the canoe should be painted. The object in painting the inside is to prevent any water getting between the framework and the skin and thus rotting the canvas. Particular attention must be paid to all inside corners and edges of the stringers; the frame also must be painted before stretching the skin. There is nothing better than ordinary paint, but see that the white lead is good and not half whiting. Use plenty of boiled oil for the last coat, as salt water tends to harden paint. There is not much difference as to the durability regarding the effects of salt and fresh water.

Removing Brunswick Black.—To remove Brunswick black from a stone mantelpiece previous to painting it, use American potash dissolved in water, and made into the consistency of paste by adding newly slaked lime. Apply this with an old brush, and let it remain on for a few hours, then wash off; if the first attempt does not remove the black, repeat the process. Care must be taken when using the potash, as it is dangerous to fingers and nails; should any of the liquid get on the hands, they should be at once well washed in water containing a little vinegar or a few drops of acid.

Preventing Rust in Kitchen Boiler.—A boiler can often be cured of rusting by giving it two or three coats of limewash to which has been added a little size to act as a fixative; about the same proportions should be used as in making a whitewash for a ceiling, but builders' ordinary quicklime must be used. The first coat must be well rubbed in. Before applying the limewash the boiler should be thoroughly cleaned, and as much rust as possible removed from the surface; then let it dry.

Meaning of Term Kilowatt.—This is a measure of electrical power or rate of doing work, and means 1,000 watts. It is usually applied to large electrical outputs, and can be determined by multiplying the electro-motive force in volts by the current in ampères and dividing by 1,000. Thus, if the electro-motive force at the terminals of a circuit were 200 volts, and the current in the circuit 250 ampères, the output would be $200 \times 250 = 50{,}000$ watts, or $\frac{50{,}000}{1{,}000} = 50$ kilowatts.

Sham Timber Building.—The usual way to get an appearance of old-fashioned timber work on a house is by nailing boards on the brickwork to represent the framed timber and plastering the intervening spaces flush with the wood; the plaster to be afterwards whitewashed, and the boards painted a dark brown. Tolerably stout deal boards should be used, and for plaster, Portland cement, with a fair proportion of sand, is advised. The arrangement of the sham timbers is a matter of taste; but suggestions are given in Figs. 1 and 2. By the "look-out in the roof" it is presumed that a dormer window is meant. The illustrations show such a window, which recedes a little from the eaves. It rests on, and is framed to, the rafters of the roof. Its triangular sides and gable will be of lath and plaster. In the elevation (Fig. 2) a roughly carved barge board is shown in the gable. This adds much to the effect, and should not be omitted.

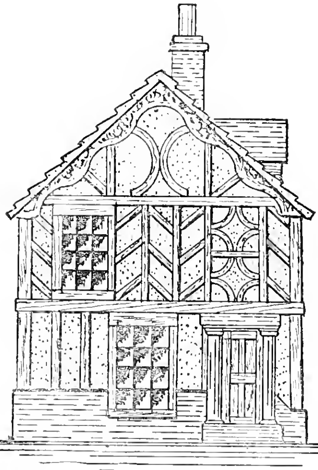


Fig. 1

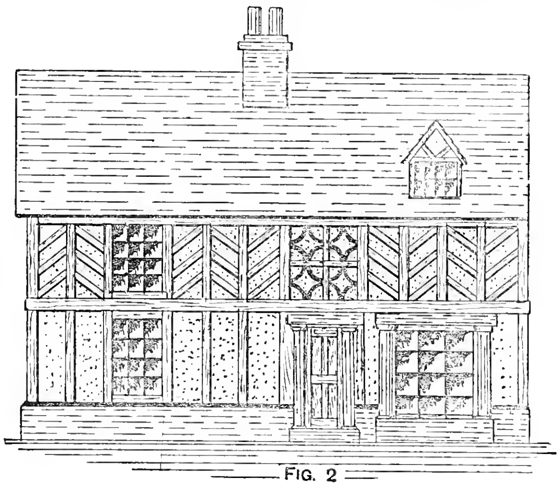


Fig. 2

Sham Timber Building.

Enamel for Coating Pills.—Finely powdered French chalk forms the white enamel used as a coating for pills. The pills are first dipped in a sugar syrup containing white of egg, then placed in the chalk in an agitating machine, the shaking thus polishing the outer surfaces of the pills and producing the enamel-like surface. The shaking could be done in a tin box if desired.

Far-reaching Signal Sounds.—An organ reed—that is, a reed with a vibrator larger than its aperture—produces a more powerful sound than any instrument of the flue-pipe variety. The wind pressure in each case being equal, a low note can be heard at a greater distance from its source than a high note, but a low note requires a larger tube. A note within the limits of a man's voice, say low F, would be suitable. This note could be produced with a tube about 3 ft. long. A great pressure of wind is not required. The most powerful organ pipes speak under a pressure of about the weight of 12 in. of water, that is, about 63 lb. to the square foot, but everything depends on the weight and flexibility of the vibrator. The conical tube used for a speaking trumpet is a suitable shape for a mouthpiece. Two instruments could be adopted, which may be used either together or alternately. A short sound followed by silence is better than a continuous note. If two notes are used together, they may be nearly alike as is the duplex whistle used by the police, or they may be tuned in the interval of a third major or minor. The combination of two sounds nearly alike gives rise to "beats," which are very effective as "noises." With two sounds representing the dot and dash of the Morse alphabet any signal can be transmitted.

Distinguishing Good and Bad Fur Skins.—When appreciating the good and bad points of skins of mink, marten, and other fur-bearing animals, every skin has its own special points, and age, season, and even sex must be taken into consideration. In a general way, the pelts of immature animals will be of little value—those from breeding females will in most cases be of no use—and every hole or tear will take off some value even from good skins. The best skins are obtained during the coldest parts of the severest winters, when the underlying fur—the soft, downy part nearest the skin—will be thickest, and the internal part of the actual skin most free from black spots and patches.

Graining Walnut in Water-colour.—For the groundwork, give a coating of white lead 2 lb., Oxford ochre 2 oz., Venetian red 2 oz., burnt umber 1 oz., thinned with equal parts of turps and boiled oil. Damp the work thirty-six hours afterwards with water 7 parts, beer 1 part, then brush it over with weak beer, burnt sienna, and a little vandyke brown, and, when dry, mottle it with a large mottler. Now over-grain with a hog-hair over-grainer dipped into a thin mixture of vandyke brown and weak beer; use it very freely, and soften upwards only. While this is wet, the dark veins and curls should be put in with an over-grainer, using drop black thinned with weak beer. Soften in all directions. Glaze or shade with drop black and a little indigo. Do not overcrowd the work. When dry, it is ready for varnishing. Take as a pattern for the graining some article of furniture in walnut, such as the case of a piano.

Oak Finish for Yellow Pine.—Staining and French polishing will give the colour of oak, is generally considered the best finish, and is readily cleansed. Pine finish is easier to gain; generally the polish only will give it this appearance, especially if dark-coloured shellac is used. Mahogany and walnut tones are considered superior, the colour being gained by first staining. Oak is not advised as a first effort: to make the work look really well, and pass for oak, requires rather clever treatment. Shellac, 6 oz., dissolved in 1 pt. methylated spirit, makes French polish as used by most polishers. It gives best results when applied by means of polishing pads, but if applied with a camel-hair brush 2 oz. of resin should be added.

Varnishing Oil Paintings.—To finish oil paintings that have not been varnished, they should not, as a rule, be entirely coated with varnish, as this will tend to make them objectionably glossy. When a painting has become thoroughly dry, certain parts of it will be much duller than others, and these parts may be brightened by applying a little raw linseed oil with a hog's-hair brush. If the whole picture is dull and requires varnishing, a thin coat only of varnish may be put on. Both varnish and oil should be bought from an artists' colourman.

Polishing Flooring.—First coat the floor with a solution of patent knotting, made by adding ½ gal. of methylated spirit to each gallon of knotting. Place near the fire for half an hour; shake well before using. One hour after applying the first coat, glasspaper slightly; then give another coat. Now take some crude paraffin or paraffin wax and thin with turps; put this on with a brush. Now take a 14-lb. polishing iron, which has a long handle like a sweeping brush, the iron working on a swivel, heat it on a coke fire, then work it rapidly to and fro over the flooring. Do a small piece of flooring only at one time.

Perforated Metal Screen for Window.—To make a perforated tin or zinc screen for a window frame 35 in. wide by 30 in. high, cut from the metal sheet a rectangle 31½ in. by 29½ in. A tube frame round the edge makes a neat and strong finish. Now cut two lengths of ⅜-in. split brass tube 35 in. long, and two lengths for the ends 30 in. long; make the cuts at an angle of 45° so that the pieces of tube will mitre, and measure the lengths along the side of the tube opposite to the split seam. Place the tubes in position round the perforation, solder the corners strongly, and solder a semicircular-shaped piece of metal with a hole punched in it to the tube at the top corners, so that the screen may be hung on two brass hooks fixed at the sides of the window. Clean off the solder at the mitre joints, polish the tube, and enamel the perforated part green or other suitable colour, and the screen is finished.

Simple Folding Table.—Fig. 1 is an underneath plan of the folding table. A narrow frame A, about 2 in. deep, is fixed by means of screws or wood buttons to the underside of the top. The legs are connected to end pieces B, and fold inwards. The connecting pieces B are rebated on the inner edge, 6 in. by ½ in. The piece C is 6 in. wide and ¾ in. thick, and is screwed to the centre of the table top as shown. This piece fits into the rebates cut in B, and serves as a spring to keep the legs rigid when the table is set up. Fig. 2 is a half elevation of the table showing the spring C fixed in the leg.

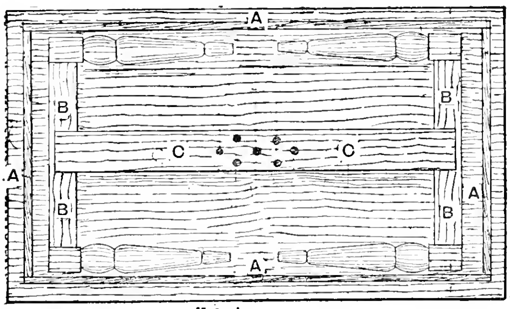


FIG. I

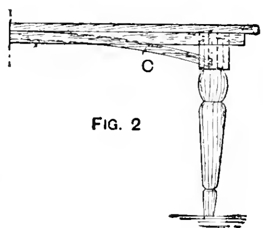


FIG. 2

Simple Folding Table.

Painting Compo Work on Building.—To paint stone-colour newly compoed work on the front of a house, mix well together 7 lb. of dry red lead, ½ gal. of boiled oil, 1 qt. of turps, but no driers. Coat the compo with this, and let it stand for forty-eight hours. Now take 7 lb. of white lead, ½ gal. of boiled oil, 1 qt. of turps, and ½ lb. of patent driers, and give the compo two coats of this, letting it dry well between each coat. Forty-eight hours after the last coat, take 7 lb. of white lead, ½ lb. of yellow ochre, and ½ lb. of patent driers; thin with boiled oil so that it will cover nicely. For washing down the remainder, boil in 1 gal. of water until dissolved ½ lb. of soap cut into thin shreds, then add one tablespoonful each of alum and carbonate of ammonia. Apply thoroughly with a brush, and wash off with cold water before the ammonia has had time to act on the paint.

Asphalt Damp-proof Course.—An ordinary damp-proof building course may be made by mixing 12 gal. coal-tar, ½ cwt. pitch, and 2 gal. creosote oil. It will take nearly an hour to melt this quantity, and it should not boil more than a few minutes. After being poured upon the wall, which should be first swept and quite dry, it should be sprinkled with sand. The above quantities will cover about 12 sq. yd.

Composition for Making Cheap Combs.—The combs sold at a penny each are usually made of celluloid, a composition produced by treating collodion cotton with camphor and methylated spirit. The camphorated spirit dissolves the collodion cotton sufficiently to convert it into a gelatinous mass which can be pressed to any desired shape, and after evaporation of the alcohol this material becomes quite hard. To cheapen the material, large quantities of starch, zinc oxide, whiting, or barytes are mixed with the above material, yielding the ivory or bone-like products usually seen. The coloured varieties are made by incorporating pigments with the celluloid, and tortoiseshell and other forms are made by special treatment. To soften celluloid, break it small, add a small quantity of camphor, and then add sufficient spirit to cover the mass. After standing a few days it will be soft enough to work. Horn can be softened, but not dissolved, by treating it with caustic soda for a short time, while prolonged action of the alkali will convert it into glue.

Copying Manuscript by Photography.—The cheapest plan of copying manuscript books is to use one of the ordinary methods of copying written matter. This, however, necessitates the first copy being written out with special ink. If the writing is on one side of the paper only, procure some fairly pure paper and mix together (A) potassium ferricyanide 2½ oz., water 10 oz.; and (B) ferri-ammonium citrate 2½ oz., water 10 oz. Mix an equal quantity of each, and coat the paper by rubbing the solution well over it several times with a soft sponge or tuft of cotton wool. The paper should be coated as evenly as possible, but no notice need be taken of streakiness, so long as the paper has been well covered. A convenient tool consists of a glass tube through which slides a loop of fine wire holding a tuft of wool. When pulled up tight, the wire is wound around the top of the tube. As the potassium ferricyanide is exceedingly poisonous, it is not advisable to get more on the fingers than can be avoided. The paper is printed in contact with the drawing or writing in the usual pressure frame, or the sheets may be fastened together with wooden clips between two pieces of glass. Printing on this paper requires a longer time (six to ten times) than silver paper; but on taking the print from the frame it merely requires washing in water, to the first bath of which it is advisable to add a little citric acid. This process gives white letters on a blue ground. For black lines on a white ground the following is recommended. Make up three stock solutions: (A) Gum 1 part, water 5 parts. (B) Ferri-ammonium citrate 1 part, water two parts. (C) Ferric chloride 1 part, water 2 parts. For use, take (A) 30 parts, (B) 8 parts, (C) 5 parts. Develop with potassium ferrocyanide (or yellow prussiate) 50 gr., water 1 oz., and fix in a 10-per-cent. solution of hydrochloric acid. If the writing is upon both sides of the paper, the only plan will be copying through the camera. The book must be taken to pieces, and pages in consecutive order arranged on a board to go as near as possible into the size plate to be used, and copied on process plates, using hydroquinone developer. From these negatives enlargements could be made, or the optical lantern could be used. Great care must be taken to get a thoroughly sharp negative: use a lens with a flat field or a small stop and keep the negatives fairly thin. If, for example, the pages are 6 in. by 4 in., then twenty-four of these could be copied in one exposure on a half plate, making seventy-five exposures in all. The wet collodion would be the best and cheapest process to employ.

Removing Iron Stains from White Marble.—Surface iron stains may be removed by applying a solution of oxalic acid and then washing with water; but if the stains have penetrated through the marble, they cannot be removed. They may be covered by applying a little lime cream (lime slaked with water) and, after drying, brushing over it a solution of silicate of soda, but this coating would be without polish. On highly polished marble, zinc-white ground with copal varnish and turpentine carefully applied might serve to cover the stains.

Removing Damp Stains from Pictures.—To remove damp stains from prints or engravings, they are immersed in a bath containing chloride of lime. Pastels, water-colours, and pencil sketches are more difficult to work upon; in fact, in the case of these latter it is almost impossible to remove damp effectually.

Double Seats for Shop.—Figs. 1 and 2 show the ends of two seats different in design for the centre of a shop. Fig. 1 is a double seat, with a footboard 10 in. wide raised 6 in. from the ground. Fig. 2 is a double seat 1 ft. 8 in. from seat to ground and 2 ft. 4 in. wide, with one centre back rail. The seat shown at Fig. 1 is 2 ft. 10 in. wide and 2 ft. 1 in. to the ground, and will be found very useful, as it enables the shopman to fit boots easily, A and B are back rails, and C the top rail. A centre leg will be necessary under the footboard and seat, and cross bearers framed into the longitudinal rails. The footboard may be made movable by framing the rails into the legs of the seat and fixing them by means of a bolt through each leg, tightened up on the inside with a wing nut.

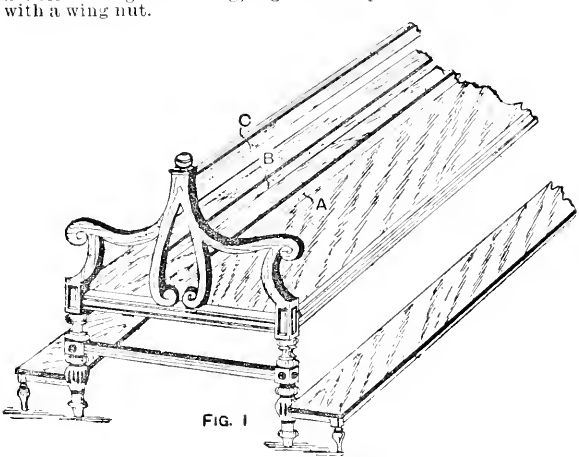


FIG. 1

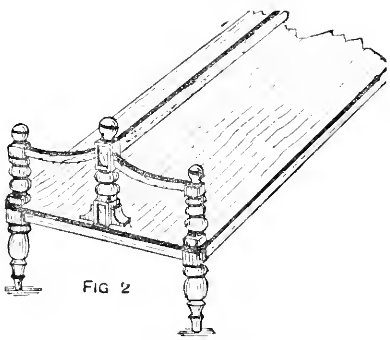


FIG 2

Double Seats for Shop.

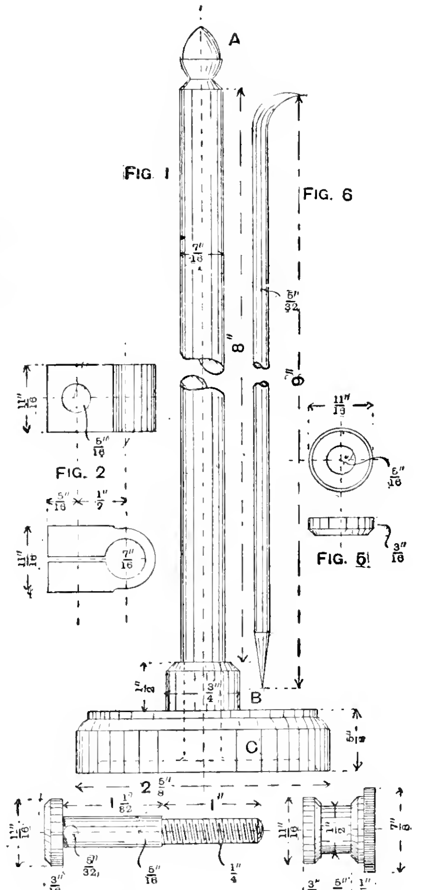
Strength of Beam.—The usual formula for finding the strength of a beam when simply supported at both ends is—

$$W = c\,\frac{b\,d^2}{L}$$

Where W = breaking weight in cwt. in centre, c = constant (3·6 spruce fir, 4·0 Northern pine, Dantzic, and Memel, 3·5 Riga, 4·3 Baltic oak, 5·0 English oak), b = breadth of beam in inches, d = depth of beam in inches, L = clear span or length of beam between supports in feet. Where the load is distributed a beam will carry double the amount. The safe load for temporary work may be one-sixth of the breaking weight, but for permanent work it is better not to exceed one-tenth.

Cleaning a Plaster Bust.—The best method of cleaning a plaster bust when it has got blinded by the finer markings getting dulled with dirt, is by careful scraping. If the whole figure is simply stained, or presents a dirty appearance, the best way is to give it a coat of knotting—a fine varnish that may be bought from any house painter—and, when this has become thoroughly hard, paint the whole with whitewash, adding a little glue to keep it from rubbing off too readily. Whitewash is preferable to paint for the reason that when the former becomes soiled it is easily removed by soaking the bust in water. The water will soften the whitewash, but leave the varnish underneath intact, thus making it possible to retain any delicate modelling there may be, and preventing the finer parts from getting filled up as they would be if a succession of coats of paint were applied. To attempt to wash the figure would only be to further rub in whatever dirt there was on it.

Making a Scribing Block.—The scribing block shown in the accompanying illustrations is made from a rod of mild steel 10 in. long and ½ in. in diameter. This is turned down to $\frac{7}{16}$ in., finished smooth, and quite parallel throughout its length. The top is finished off as at A (Fig. 1), and the other end, for rather more than 1 in., is turned and threaded ⅜ in. A collar B is then screwed on tightly. The bottom disc of iron or



How to Make a Scribing Block.

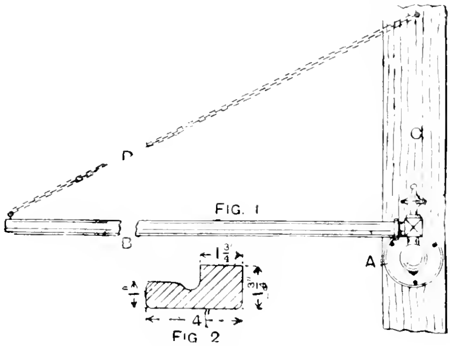
gunmetal C, with the bottom dished out, is tapped to suit the post. The hole in the sliding block (Fig. 2) should be a sliding fit on the post, the saw cut meeting the large hole; this will enable the block to grip the rod and scribing point when the nut (Fig. 3) is tightened. The steel pin (Fig. 4) should be turned, drilled, and threaded to fit the nut. Two washers (Fig. 5) are required, one being grooved diameterwise for the scriber to bed into; they are placed one at each side of the block (Fig. 2). The ends of the scriber (Fig. 6) should be hardened and tempered.

Clarifying Dextrine.—A solution of dextrine may be rendered clear by adding to each pint ½ drachm of alum dissolved in ¾ oz. of water; shake thoroughly, and then add ¼ drachm of washing soda dissolved in ½ oz. of water; again shake, and allow to stand for a few days. The hydrate of alumina precipitated out will carry with it the suspended matter and some of the colour, leaving the liquid much clearer and brighter.

Stiffening for Straw Hats.—For stiffening straw hats, thin glue size applied warm is generally used. Ordinary glue size may be employed for coloured straws, and parchment size for white straws. For black straws, add a little aniline black to the size to colour it. Spirit varnishes may be used for stiffening straw hats; ordinary French polish, diluted with methylated spirit, is also suitable.

Etching Brass Plates with Acid.—First make a pencil drawing on paper of the lettering to be etched; plain block letters will be the best for the purpose. Then get a brass plate of the size required and about ⅛ in. thick, and coat its polished side with white wax or ordinary bees-wax. To do this, heat the plate and rub the wax evenly over the surface; then transfer the lettering to the waxed surface of the plate by means of carbon paper placed between the plate and the sketch, and marked with a pencil. The letters will then appear plainly on the plate. Then carefully scrape away the wax inside the outline of the letters, care being taken not to remove the wax from any part of the plate not to be engraved. A wall of wax is then put round the plate to retain the acid, which is then poured on the plate and left there until it has bitten deeply enough, when it is poured off and the plate washed in clean water. The plate should then be polished and the letters filled in with black japan varnish.

Simple Curtain Rod.—The accompanying sketches show at A an old gas bracket, large enough for a ¾-in. rod as B fitted with curtain rings supporting the curtain. The bracket is screwed to the door-post C, and a brass eyelet in the far end of the rod holds a brass chain D so that it will bear the weight of the rod, etc., the chain being attached to the post about 20 in. above the bracket A. Fig. 2 shows a piece of wood which is fastened to the wall to act as a stop to the rod.



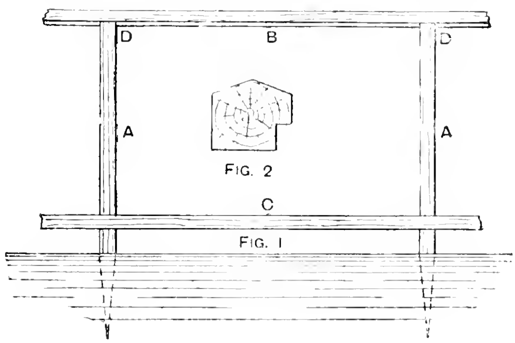
Simple Curtain Rod.

Re-covering Cushion with Moquette or Wilton Pile.—For a seat 20 in. wide, allow 21 in. for the top, 1 in. for the joining seam at the back, 6 in. for the square front, and two piped seams, making a total width of 29 in., providing the seat cover is made out of one piece, as is usual with edge seams of cushions made of moquette or strips of leather. The heavy pile of the cloth prevents a neat appearance. The under lining can be made of black glazed linen. Machine up before commencing to stuff, leaving one corner open to put in the stuffing materials. If deep tufts are required, do not pack tight. If the front and back are made square the cushion will be reversible. Moquette is the French name for Wilton pile.

Aunt Sally Gallery.—An Aunt Sally gallery should be from 15 ft. to 20 ft. long and from 10 ft. to 12 ft. wide, and the apex of the roof from 8 ft. to 10 ft. high, sloping from 5 ft. to 6 ft. at the side. The posts or uprights, 18 in. of which should go into the ground, should be about 3 in. square; the apex piece for the roof should be 1 in. wide and 1 in. thick, and the framework for supporting the canvas should be 2 in. square. Fasten the woodwork together with small carriage bolts. The dolls, of which there may be one, two, or three rows, should be about 2 ft. high and about 2 in. apart, six or eight dolls being placed in each row. The foundation for a doll is a stick or piece of wood about 2 in. square and 2 ft. long. The head of the doll is made of tow or rags tightly wrapped round one end of the stick till it forms a ball 8 in. in diameter. The ball is covered with calico, the ends of which are tied round the neck of the doll; a coat of white oil paint is then applied, after which the face is painted in. The body of the doll is fashioned from rings of steel wire, the ends of which are bedded in the wood. First ring, the neck, 3 in. in diameter; second ring, the shoulders, 7 in.; third ring, 6 in.; fourth ring, 5 in.; fifth ring, the bust, 4 in.; sixth ring, the hips, 5 in. Rings 1 and 2, 1 in. apart; all the other rings 2 in. apart. The rings are connected to each other by lacings of finer wire, passing from top to bottom, the space between the lacings being 2 in. in the largest ring. The legs are made of calico stuffed with tow, and are attached to a piece of wire, 4 in. long, that has been driven through the centre of the wood just below the sixth ring. A frilled cap is placed on the head, and the dolls are otherwise dressed according to taste. Hinges are used for fixing the dolls to their perches.

Coke-breeze Concrete Floor. In a large area of coke-breeze concrete flooring, the coke breeze should pass through a sieve of ¾-in. mesh, all larger pieces being broken smaller, and be retained on a sieve of $\frac{1}{16}$-in. mesh, all the dust that passes through being rejected. The proportions should be $2\frac{1}{2}$ parts of coke breeze, 2 parts of sharp clean sand, and 1 part of Portland cement. The whole of the materials should be carefully measured, and thoroughly mixed in a dry state. The water should afterwards be added slowly through a rose nozzle, and the materials turned over again at least twice to ensure thorough mixing.

Fixing Trellis Work.—The best way to fix a fence of trellis work is to drive stumps (A, Fig. 1) into the ground, and to nail on them a top rail B and a bottom rail C. The trellis can then be nailed to the face of the stumps and rails. The top rail should be 3 in. wide by $2\frac{1}{2}$ in. deep, the top being bevelled off to each side as shown in the section (Fig. 2), and a 1-in. by ½-in. rebate made on the face side. The stumps should be $2\frac{1}{2}$ in. square, and must be driven in the ground about 18 in., the top then being cut off to the right height. Each stump must be notched to receive the bottom rail, which must also be notched, so that when the two are together they will be level or flush on the face side. The top rail must be notched the depth of the rebate to fit on the top of the stumps, as shown at DD (Fig. 1), and, in fixing it, the rebate must overhang the face of the stumps; this prevents the wet from getting to the ends of the laths. The end stumps must be rebated in the same way as the top rail, to give a better finish.



Fixing Trellis Work.

Fitting a Mainspring to a Skeleton Clock.—Take the clock to pieces and obtain a spring of the correct height and length for the barrel. This should be about $\frac{1}{32}$ in. less in height than the inside of the barrel, and when in, its wire should just be capable of slipping inside. Ease off the wire tie to the top edge, and slip the spring in, taking care that the hole for the hook is in such a position that it will slip on the barrel hook. When in as far as it will go, cut the wire tie and knock the spring quite down to the barrel bottom by taking the barrel in the hand and striking the bottom heavily on the floor or on a wooden bench. If unable to do this, hold the spring in a duster to protect the hands, and cut the wire tie. Then commence at the outside end and coil the spring in a portion of a turn at a time, holding it tightly to prevent it slipping out. Rest the barrel on a firm stool during the process and hold it with a duster for protection. The operation requires a firm wrist, as the spring must not be relaxed in the slightest degree until it is all in. A little bending with pliers when it is in will ensure the spring catching on the barrel arbor hook in the centre. When in and the cover is on, screw the square in a vice and, with the hands, wind it up by turning the barrel to the top to see that all is right. Plenty of oil should be applied.

Affixing Gold Leaf to Glass.—The only reliable medium for affixing gold leaf to glass is weak isinglass dissolved in rain-water. The backing should be red lead ground in varnish and thinned with turps. Cracking and chipping at the edges is due to the use of Brunswick black, japan, and asphaltum; these materials are unsuitable, because cold contracts and heat expands them to a very marked degree.

Cement for Repairing Marble.—A simple and excellent cement is made by beating the white of an egg in flour till the mixture is of the consistency of thin paste. This cement will even withstand hot water, and, on account of its colour, is not easily detected. Clear shellac or superfine plaster of Paris may also be used.

Method of Working Mouldings on Arches.—Arches of moderate span, say about 6 ft., can be worked as follows:—Two pieces of timbering should be bolted to the caps of the brickwork columns, on which another piece is fixed to take the bolt which is in the centre of the arch, and holds the radius rod in position (see elevation of arch, Fig. 1). A radius rod should be prepared, to the end of which the templates necessary to run the mouldings can be fixed. The plain part of the wall above arches should be flanked in with Portland cement, this then forming a screed on which the mould to work mouldings can travel. A mould should then be cut from a piece of wood to the shape of the moulding, ¼ in. less being allowed in every part to allow for the finishing coat. After this has been used to run the moulding in cement, another should then be prepared to the exact shape and size required, this one being faced, as shown in section of arch (Fig. 2), with either copper or zinc. The fine stuff is then laid on the cement backing, and worked to the required section by moving this mould round the arches by aid of the radius rod, as shown. After the moulding has been finished, the key block can be moulded and placed in position. The intersections of the arch mouldings can all be run by having the top part of the template, from the dotted line A upwards, hinged on to the radius rod, so that it can be held back while passing over intersecting points.

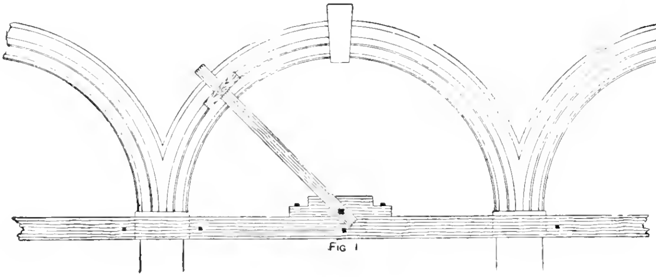


Fig. 1

Fig. 2

Method of Working Mouldings on Arches.

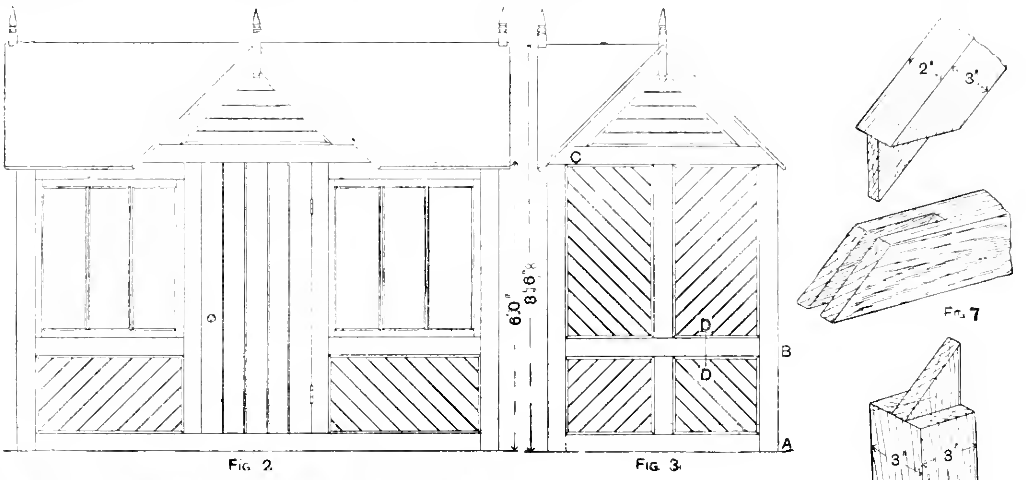
Improving Furnace for Melting Lead Ashes.—To improve a cube lead-melting furnace from which the slag comes out with the lead and blocks up the hole, the temperature of the furnace should be raised gradually and air allowed to enter the furnace to oxidise the sulphur contained in the coke. The front of the furnace should be luted with clay, and a tap hole made to remove the slag above the lead. If this cannot readily be done, add a shovelful of lime to stiffen the slag. The temperature can then be raised and more lime thrown in, if necessary, when the slag can be removed in lumps. A comparatively low temperature is required for rich slags and a high temperature for poor slags.

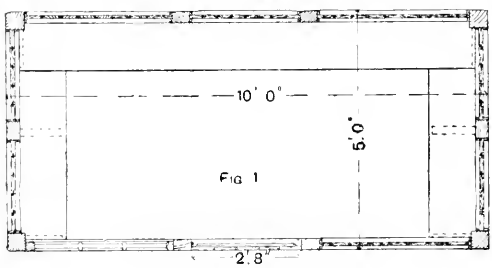
Making Saucepans.—When making round-bellied saucepans, first cut the pattern for a frustum of a right cone, using the length of the curve of the side as the slant for the cone, and the top and bottom diameters of the saucepan for the diameters of the ends of the cone. The body is hollowed, usually in tacks of four, on a tinman's block. Commence by working across from side to side on the block until the whole surface has been covered and the metal slightly hollowed equally all over. Now take the metal over a deeper hole in the block, and work along the bottom edge and up to the centre of the body, so that the curve of the lower part of the body stands out more boldly than the top. Again work over the whole of the surface until the metal is smooth. The tacks of bodies are then smoothed on a planishing wheel, separated, cleaned, and planished singly, either on the planishing wheel or on the anvil. A square notch is next cut at both ends of the top, and a corner notch at the bottom of the body. The ends are then prepared for a grooved seam by folding an edge over on one end upon the hatchet stake, and the opposite end is swaged with a hammer swage, which forms a bead of semi-circular section along the edge. Half of the bead is worked over inside with a round-faced hammer on a hatchet stake so as to form a fold, into which the fold on the opposite end will fit when the body is turned round. A flange is next thrown off along the top edge with a round-faced hammer on an anvil stake, and this flange is worked over towards the outside of the body upon a hatchet stake, the size of the flange being proportionate to the size of the wire which it is to cover. Draw the fold down over the wire with a mallet, using a round-headed stake for the body to rest on, and then close the fold down neatly over the wire with the wiring machine. With the mallet work round the two ends of the top to a radius equal to the top of the body, and then work the body round by pressure from the hands upon any convenient tool until it is circular at both ends; hook the folds together and draw them together closely upon the saucepan belly stake with a groover. Throw off an edge at the bottom with a jenny. Cut out the bottom, making it sufficiently large to allow an edge to be taken up to fit over that thrown off on the body. Planish the bottom by covering the surface with a number of blows from a flat planishing hammer upon a bright anvil. Next edge up the bottom and pene down the edge upon the edge on the body, work the edges partly over upon the hatchet stake, and close it down smooth and true upon a mandrel. Next rivet on the handle, solder round the bottom, along the groove, and over the rivet heads to complete the body. If a lip is required, the wired edge of the body is held firmly on an extinguisher stake at the place where the lip is to be formed, and a few smart blows are given with the heel of a mallet upon the wire at each side of the stake. A lip punch is then held firmly on the body from the wire downwards, and a blow delivered upon this gives the required taper. Oval bodies are the same size at the top and bottom, and are usually made in four pieces, the seams being formed in the same manner as for the round ones, and occurring at the parts of the oval where the side curve joins the curve of the end. When hollowing, the end pieces are hollowed deeper than the sides, and equally at the top and bottom. Oval bodies are usually wired after being grooved together.

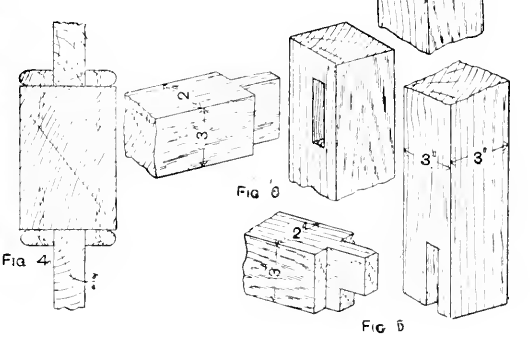
Warming Buildings by Hot Water.—The customary method of calculating the amount of hot-water radiating surface required to warm a building is to allow so many superficial feet of radiating surface per thousand cubic feet of space in each room, hall, or corridor. Thus, in living-rooms (a dining-room, for instance), it is usual to allow 15 ft. of radiating surface per thousand cubic feet of space, and such a room measuring 15 ft. by 20 ft. by 12 ft. high—which would have 3,600 cub. ft. capacity—would need a radiator with 54 ft. of surface to it. Entrance halls need 20 ft. per 1,000, as practically all cold air enters here and should receive warmth before going farther. Bath-rooms, 20 ft. per 1,000; bedrooms, 10 ft. to 12 ft. per 1,000. These figures will give an idea of what will be needed for other purposes. They will afford a temperature of about 62° when there is a hard frost outside. The piping used is the "red steam" quality. This is stronger than gas or water pipe. Custom has decided that this is the quality of pipe to use, but except in very high buildings such a thick pipe is not needed as regards its ability to resist pressure. Boilers are made of $\frac{5}{16}$-in. and $\frac{3}{8}$-in. iron, and capable of withstanding any ordinary pressure, but with high buildings the saddle boiler or any shape having large flat surfaces should be avoided, as the plates may bulge out.

Removing Zinc from Solder.—To remove the zinc, just melt the solder in a pot, then take it off the fire and stir in a good handful of powdered sulphur or brimstone until the whole is of the consistency of wet sand. Replace the pot on the fire and melt, *but do not stir* the contents. The sulphur and zinc will rise to the surface and form into a cake. Now take the pot off the fire and carefully remove the cake without breaking it if possible. This can be done with two pieces of hoop iron with bent ends.

Design for an Arbour.—Fig. 1 is a plan with dimensions marked, Fig. 2 a front elevation, and Fig. 3 a side elevation; at Fig. 4 is shown a section through a rail and boarding, as at D D (Fig. 3). Fig. 5 shows the construction of the joint at A (Fig. 3), Fig. 6 that at B, and Fig. 7 the group at C. The general dimensions and sizes of the principal members are also shown. For the panels and roofing, ¾-in. prepared matchboarding will be most suitable; the roofing should be covered with felt. The sash could either be made fixed or hinged. The arrangement of the seats is shown in Fig. 1. A simple method of fixing the boarding to the framing by means of beads at each side is shown at Fig. 4.







Design for an Arbour.

Making Moulds for Sugar Toys.—First make a model of the toy in wax, and take a cast of this in plaster of Paris. To do this, procure a small wooden box which will hold the wax model comfortably. Mix some plaster of Paris with water to a very thick cream, and pour enough of this into the box to about one-third fill it. Next place the wax model upon the plaster with its base pressed against one side of the box, and fill up with more plaster. When the plaster has set, take the box to pieces, remove the wax model, and with a fine saw very carefully cut the mould in half. The cut faces may be smoothed by scraping carefully with a knife so that they fit close together. The mould may be improved by warming and rubbing it with warm paraffin wax or a waxed cloth until it has received a slight polish. In using the mould, bind the two halves together with rubber bands and force the sugar paste or syrup through the opening left by the base of the wax model until the mould is quite full. The colours now used are harmless coal-tar (aniline) dyes sold specially for the purpose. If a glaze is employed, it is either sugar syrup alone or sugar syrup to which white of egg has been added. The toys made from pure sugar will not melt in the sun.

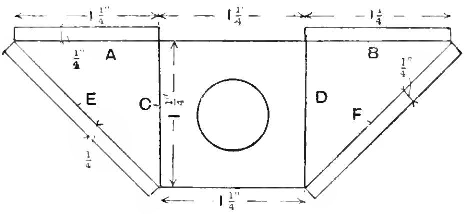
White-enamelling Furniture.—For white-enamelling the surface of new wood, the foundation is built up with gilders' washed whiting and patent or parchment size; three coats at most should prove sufficient. This is smoothed down with worn glasspaper. At least four coats of white enamel should then be applied, allowing each coat time to dry before applying the next. A superior finish can be obtained by French polishing the surface, using transparent polish with or without the addition of flake white, as the undercoating may require. If the furniture has previously been enamelled, it is not necessary to remove the old enamel right down to the wood. The surface should be freed from grease by thoroughly washing with warm water in which a small teacupful of washing soda has been dissolved. A little pumice powder will prove beneficial if the furniture is very dirty. The whiting and size may be omitted, and the surface built up with two coats of white enamel, as in new work. A suitable enamel can be made by mixing finely crushed flake white in transparent polish; strain through muslin before use. For a bright finish, mix flake white in best quality white hard varnish.

Fitting a New Mainspring Barrel to a Watch.—In an English lever with fusee and chain, the fitting of the barrel is a very simple job, the barrel being merely a brass box. Take the rough barrel and broach out the bottom hole to fit the bottom shoulder of the barrel arbor tightly. Serve the cover in the same way. Then turn the inside of the cover central boss down until the top shoulder of the barrel arbor just appears through. Turn down the inside bottom boss until the arbor has just a little endshake in the barrel; then put in the hook and cut the chain hook-hole. For the latter, drill two small holes in the barrel and broach one slanting into the other. To turn the barrel and cover with turns, place them on arbors; with a watch lathe, hold them in step chucks and use the slide-rest. For a Geneva barrel with stopwork, if possible use the old cover with the stopwork on. When finished, ease the arbor in the holes at top and bottom.

Finishing Cement Cornices.—A smooth finish is obtained by the use of fine Portland cement mixed neat. As this works "short," it is left a little time till it begins to set; then fresh water is added, and it is beaten up again. This process brings the cement to the state known as "killed," when it sets more slowly, attains a less ultimate strength, and works easier in the running of the mouldings. If this last coat is laid some time after the body of the work has set, it is advisable to wet the surface on which it has to be placed so that the moisture is not drawn out of the finishing coat too quickly.

Material for Sketching on Glass.—To make the material used by sign-writers for outlining letters, etc., on glass, melt together 4 parts of stearic acid, 3 parts of mutton suet, and 2 parts of beeswax. Add 6 parts of red lead and 1 part of purified carbonate of potassa. Mix well together and pour in glass tubes or hollow reeds to set.

Making a Finder for a Hand Camera.—To make a finder for a hand camera, procure a plano-convex or bi-convex spectacle lens, unedged or centred, of about 1-in. focus (cost, 3d.); also a piece of zinc and a piece of silvered glass. Cut the zinc to the shape shown in the figure, and bend on the lines A, B, C, D, E, and F. The first two, being bent outwards, enable it to be attached to the camera top; and the last two, bent inwards, form a support for the ground glass, which rests at an angle of 45°. Without knowing the make of camera it is intended for, it is impossible to state how the finder should be finished and attached; a very common plan, however, is not to make the finder complete in itself, but to let the camera top and front form the remaining sides. In this case, cut an opening in the camera top 1¼ in. by 1 in., and sink a rebate to hold the ground glass, rough side inwards. This may be fixed in with pins. Fix the frame with the mirror, and sink the lens in a recess until the image is sharp, then fasten in with a ring of wire. With strips of black paper, block out on the ground glass of the finder as much of the picture as is not shown on the screen of the camera. The best finders for instantaneous work are those of the brilliant pattern, but these are not easily made. One should be chosen the image of which does not vary with the angle at which it is viewed.



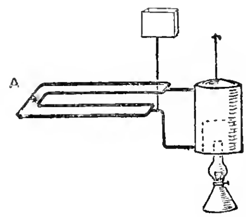
Making a Finder for a Hand Camera.

Power of Model Steam Engine. — A steam engine has a steam pressure of 25 lb. per square inch, the bore of the cylinder being 1 in., the length of the stroke 1¾ in., and the speed 350 revolutions per minute. The maximum effective pressure may be 22 lb. per square inch. The area of the piston is 1 × 1 × ·7854 = ·7854 sq. in., and the length of the stroke is $\frac{1\frac{3}{4}}{12} = \frac{7}{48}$ ft. Then, if the engine is double-acting, and the steam supply is kept up throughout the stroke, the maximum indicated power will be $\frac{22 \times \frac{7}{48} \times \cdot 7854 \times 350 \times 2}{33{,}000} = \frac{1}{20}$ horse-power (say). The maximum brake-power will be less than this—say $\frac{1}{30}$ horse-power.

Light Oak Graining.—To grain and varnish yellow deal a light oak, first kill all knots by applying a coat of shellac (knotting) over them; then prime with light colour. When the priming is dry, putty holes and make joints good, etc. Now paint a second time with light colour; when this is dry, lay on a ground made of 1 lb. of white lead, 2 oz. of patent driers, and 2 oz. of Oxford ochre. Thin with oil or turps (some grainers prefer a dead ground, others a bright ground to grain upon). Forty-eight hours after the ground is dry, rub down slightly with fine sandpaper. The work is now ready for graining. The graining colour should consist of 2 oz. of vandyke brown or 2 oz. of burnt umber. To this should be added, for a warm shade, 1 oz. of burnt sienna; for a cold shade, 1 oz. of raw sienna. Thin with equal parts of oil and turps, and add driers in the proportion of about 1 oz. to 1 pt. Brush over the work sparingly with the above colour, getting it as even as possible. Now draw a coarse graining comb down the board or panel the way the grain is to run; then with a fine comb go over the coarse combing in a zig-zag manner; this will cut up the combing like the fine fibres seen in real wood. Now take a piece of rag, fold it over the thumbnail, and wipe out the lights. The most important thing in graining is to get clean joints. Even if the work is otherwise well done, a bad joint spoils it. The work is then ready for coating with copal varnish.

Affixing Anaglypta.—When attaching Anaglypta and Lincrusta Walton to ceilings and walls, all but light quality should be trimmed with a metal-edged straight-edge and a sharp knife, such as a shoemaker's knife. The material having been cut to the required lengths and trimmed, should be pasted with ordinary paper-hangers' paste. Let it stand for fifteen to twenty minutes, then cover it with ordinary paste to which is added one-fourth glue, and at once hang the material before it commences to dry. Use a cloth for pressing the Anaglypta to the wall, as a roller presses down the relief. Lincrusta is hung in a similar manner, but for this a roller can be used, as the relief is solid. A better finish is gained by first lining the ground with a common brown paper.

Heating Chicken Rearer.—The accompanying sketch shows a small heater 8 in. by 6 in., with about 9 ft. of ½-in. pipe attached. There is an air valve on top of the heater, and a small filling cistern is connected to the return pipe. This would fail owing to air in the pipes, and it must be difficult to fill the pipes without locking air in with the pipes arranged as shown. Putting an air pipe to each pipe at the point marked with an asterisk at A should prove a remedy, these two air pipes either going up separately or joining together, but in each case they must go as high as the little cistern. This point should be the highest point in the circulation, the flow pipes from the top of the boiler rising, say, 1 in. to the air pipes, and then descending 1 in. from this point towards the cistern connection.



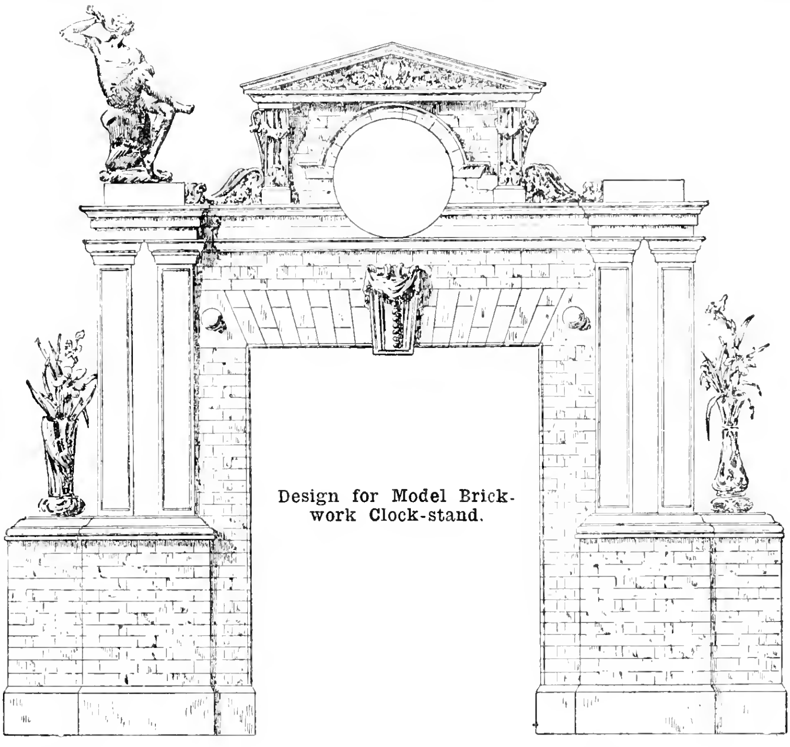
Heating Chicken Rearer.

Making Tube Chimes.—A set of chimes may be made from tubing suspended from a frame. These metal tubes are open at each end, and composed of a special alloy. Their musical pitch varies according to their thickness, diameter, and length. The longest tubes sound the deepest notes, and are usually both larger and thicker. If the tubes were all of the same material and diameter, their pitch would vary solely according to their length; and given two tubes, one twice as long as the other, the long one would sound the same note as the short one, but one octave lower. Eight is a good number for a peal, tuned to a complete octave. The distance apart does not affect the tone. The tubes are suspended by silk or leather thongs threaded through holes at each side near the top. They are struck near the top end with leather-faced hammers. To form the scale, make one (the longest, 2 ft., 3 ft., or 4 ft., according to fancy and the note desired) and set its measurement down on paper, for the longest, and another, half its length, for the shortest; then draw a slanting line from the lower end of one to the lower end of the other. If the remaining six tubes are now drawn in between the longest and shortest, at equal distances, the slanting line will cut off each to its proper length. These lengths are only approximate, and the tubes will require tuning in unison with an octave on a piano, cutting them down carefully until each one sounds the note desired.

Cement Rendering on Rubble Wall.—Portland cement and sharp sand should be used in the proportion of, say, 1 cement to 3 sand. The cost would vary with local circumstances, but might be about 2s. per yard super. for plain face finished from the hand float, with, say, 3d. per yard extra for jointing to imitate ashlar work; mouldings, say ¼d. extra per inch girth per foot run; arris edges, 1d. per foot run. A rubble wall is generally supposed to be required one-third thicker than a similar brick wall. Brickwork, say 9 in. for top floor, and 1½ in. extra for each floor below. Rubble walling, say 12 in. for top floor, and 6 in. extra for each floor below.

Working Paper Pulp.—To give the pulp tenacity, it is boiled in a solution of gum arabic or size. To make figures, the pulp is poured into the mould and a counter mould pressed over the mass so as to make the casting a mere shell. For flat articles, like trays, etc., different thicknesses of sheets of paper are glued together and pressed so as to become one. To make casts of heads in relief, stiff, unsized paper is damped and placed with the dry side next to the figure to be moulded. It is then patted with a cloth into all the markings of the object, and after about five minutes is taken off and left to dry. A polish impervious to water is obtained by using a varnish composed of turpentine, amber, and ivory black. This is applied in a heated room, and the cast afterwards placed in an oven.

Design for a Model Brickwork Clock-stand.—The accompanying design represents a gateway, over which is the opening for the clock. Two types of arches are shown—one camber or flat, the other semicircular. There is very little enrichment, and what there is might be dispensed with and plain brickwork substituted. The string-coursing, capitals, and bases of the pillars could be made of 3-in. moulded bricks. The chamfered plinth might also be constructed of bricks, though plain terra-cotta pieces of the full depth would be preferable. The brickwork could be carried out as far as the outside pillars, and still leave sufficient space for the small flower vases as shown in the design. If the space between the pillars be left empty, a second pillar will be required at the back to support the entablature. Small statuettes, vases, or any bric-a-brac, might be appropriately placed over the pillars as illustrated, or a mirror could be let into the vacant space for the gateway. An approximate idea of the sizes may be gathered from the courses of brickwork.



Design for Model Brick-work Clock-stand.

Darkening Mahogany.—To darken mahogany, enclose the finished articles in an air-tight box, on the floor of which are placed a number of shallow dishes containing liquid ammonia ·880 per cent. The fumes, which may play around for hours, have such a penetrating power that a thin shaving of the wood might be taken off without disturbing the colour; this treatment does not raise the grain. Stains may also be applied with a brush. Dissolve 1 oz. of bichromate of potash in 1 pt. of water; two or three applications of this may be given, and, when the stain is dry, the colour may be enriched by wiping over with red oil, obtained by steeping 2 oz. of alkanet root in ½ pt. raw linseed oil. Common washing soda, carbonate of soda, or water in which lime has been slaked, will give different shades. A French method is to rub the surface with dilute nitric acid, which, when dry, may be brushed over with a solution of 1½ oz. dragon's blood and ½ oz. carbonate of soda dissolved in 1 pt. of methylated spirit.

Brickwork and Foundations for Tall Chimney.—In constructing chimney shafts for Lancashire boilers, the area of the chimney at the top is based upon the size or capacity of the boilers. Thus, area in square inches $= \frac{180a}{\sqrt{h}} = \frac{100\,HP}{\sqrt{h}} = \frac{15F}{\sqrt{h}}$, where a = area of fire-grate in square feet, HP = indicated horse-power of engine, or F = quantity of coal consumed per hour in pounds. The diameter externally at the base should be $\frac{1}{10}$ to $\frac{1}{12}$ of the height. The latter should be 0·3 in. to the foot, or about 1 in 33, though this is not imperative. The brickwork should be 9 in. in thickness for the top 25 ft., and increase half a brick at each 25 ft. from the top. If the inside diameter at the top exceeds 4 ft. 6 in., the top length should be 1½ bricks thick, and each of the lower lengths consequently half a brick thicker. The foundations should be carried down to the solid; they should be spread out so as to make a good broad base, and the load on the foundation should not exceed 1 ton on the square foot. After arriving at what appears to be a solid bed, it is a good plan to sink a trial hole under the centre of the chimney some feet lower; if the ground is found to be good, the hole may be filled with concrete at 10 or 12 to 1. The base for the chimney should consist of a solid block of concrete, 6 to 1, not less than 2½ ft. or 3 ft. thick; and as concrete is cheaper than brickwork, it may be carried up in concrete to the invert of the flue.

Making Crocus Powder.—Crocus is an oxide of iron, and it is made by calcining copperas (sulphate of iron); the residue is divided into two portions, a bright red powder known as rouge, and a bluish-red powder known as crocus.

Making Putty Powder.—Putty powder is made by heating metallic tin in a furnace, and thoroughly stirring it so as to bring it in contact with the air; the tin is gradually oxidised, forming first a grey powder and finally a white powder of oxide of tin, or putty powder. The commoner kinds of putty powder are made from an alloy of 75 parts of tin and 25 parts of lead.

Graining Mahogany in Water Colour.—Mahogany graining should be worked on a ground made from white lead, venetian red, and chrome. First damp the work to be grained with a sponge dipped in water to which has been added a little fuller's-earth or whiting; this will prevent sissing. The colours required are vandyke brown, burnt sienna, mahogany lake, and blue black—all ground in water; these may be bought in tubes from 1s. each. The tools required are a 3-in. mottler, a medium-size sash tool, a thin hoghair overgrainer, a small bevelled cutter, a sable pencil, and a badger hair-softener; these would cost from 10s. upwards. The method of working is as follows: Rub up on a palette a little vandyke, burnt sienna, and lake with weak beer and water, keeping each colour separate; dip the sash tool in the colours and cover the work, which in some places should be dark and in others light, in the direction of the grain. Next dip the mottler in water, wipe it on the washleather to take out superfluous water, then mottle the work to imitate the real wood; soften off with the badger brush. Higher lights or feather markings can be taken out with the cutter; soften the work as it proceeds. The work may next be overgrained by using the thin overgrainer with blue black. Divide the hairs by drawing it through an ordinary comb whilst wet. Use the sable pencil for the fine or feather work.

Weight, Measurement, and Strength of Timber.—Information on the weight, measurement, and strength of timber is scattered through various books, from which the following table is extracted:—

Timber, Selected Quality.	*Weight lb. per cub. ft.*	*Ultimate Tensile Strength tons per sq. in.*	*Ultimate Compression tons per sq. in.*	*Coefficient of Transverse Strength.*	*Ultimate Bearing Pressure tons per sq. in. across Grain.*
White pine	28	—	1·8	3·8	·27
Spruce fir	31	1·5	2·5	3·6	·22
Larch	35	1·5	2·5	3·5	—
Honduras mahogany	35	1·5	2·8	4·9	·58
Elm	37	2·0	3·0	3·0	—
American red pine ...	37	—	2·2	4·0	—
Northern pine	37	1·5	2·9	4·0	·60
Kauri pine	38	—	2·8	4·8	—
Ash	45	2·0	3·5	5·0	—
Beech	47	1·9	3·8	4·5	—
Baltic oak	48	3·0	3·2	4·3	—
Pitch pine	50	—	2·9	5·0	·76
English oak	50	3·0	3·2	5·0	·90
Teak	50	3·0	3·8	5·0	—
Spanish mahogany ...	53	1·8	3·0	5·0	1·9
Greenheart	60	—	5·8	8·0	—
(1)	(2)	(3)	(4)	(5)	(6)

The safe load in tension and compression, columns 3 and 4, would be from one-tenth to one-fifteenth of the amounts given. The safe bearing pressure across the grain of timber as at the ends of a beam will be about one-fifth of the amounts given in column 6. Column 5 gives the coefficient C in the formula $W = C\,b\,d^2 \div L$, and the safe load would be about one-sixth of W for temporary work, or one-tenth for permanent loads.

Deepening the Colour of Electro-gilding.—When chains, etc., are electro-gilt their surfaces are coated with a film of pure gold, which assumes a pale yellow tint when deposited from a new solution, or from a slightly warm one, or by a very low tension current. The colour may be deepened by re-dipping in an old solution or in one heated to 180° F., or under the influence of a 10-volt current. If the chain is made of bronze, copper, or dark brass, or coated with a deep colour gold, the deep colour may be restored by carefully heating it on a sheet of iron over a gas stove, or over a charcoal fire. The chain must be moved about whilst being heated, and removed at once when the colour comes. When cool, it must be polished by brushing with a hard brush.

Varnishing Oil Paintings.—The primary object of varnishing an oil painting is to protect it, much in the same way as glass is put over a water-colour drawing; in fact, valuable or delicately painted oil pictures are often protected by glass, and a lot of future trouble saved. Mastic varnish is used for oil paintings because a thin coat is generally sufficient to bring out all the detail in the dark parts without giving a vulgar gloss. It has very little colour, and can be easily removed when necessary, which is not the case when a "durable" varnish, that is, one made from hard gums and drying oil, is used. An oil painting from the artist's studio should be carefully hung up to lean forward slightly, so as not to catch any dust, etc., certainly *not* over a fireplace or near a gas burner. At the end perhaps of about three years the surface dirt, fly spots, etc., should be removed with a clean wet cloth (not flannel) and a coat of varnish applied. This will protect the surface of the picture from future atmospheric influences; in fact, all dirt, etc., will be on the *varnish* instead of on the *picture*. Mastic varnish will sometimes "bloom," that is, the picture will be covered with a slight opalescent film. This can be removed by breathing on a small portion at a time and gently rubbing in small circular strokes with a tuft of cotton wadding. Never *partially* varnish a picture, because even mastic will turn yellow with age, and show an objectionable distinction between what is varnished and what is not.

Comparison of Beaumé Hydrometer Degrees with Specific Gravities.—The degrees in the Beaumé hydrometer for both heavy and light liquids can be transposed to ordinary specific gravities by the following tables, from the German. The first is for liquids heavier than water:—

B. Degree.	*Specific Gravity.*	*B. Degree.*	*Specific Gravity.*	*B. Degree.*	*Specific Gravity.*
0	1·	18	1·134	46	1·434
1	1·007	20	1·152	48	1·462
2	1·013	22	1·167	50	1·490
3	1·020	24	1·188	52	1·520
4	1·027	26	1·206	54	1·551
5	1·034	28	1·225	56	1·583
6	1·041	30	1·245	58	1·617
7	1·048	32	1·267	60	1·652
8	1·056	34	1·288	62	1·689
9	1·063	36	1·310	64	1·727
10	1·070	38	1·333	66	1·767
12	1·085	40	1·357	68	1·809
14	1·101	42	1·381	70	1·854
16	1·118	44	1·407	75	1·974

The following table applies to liquids lighter than water:—

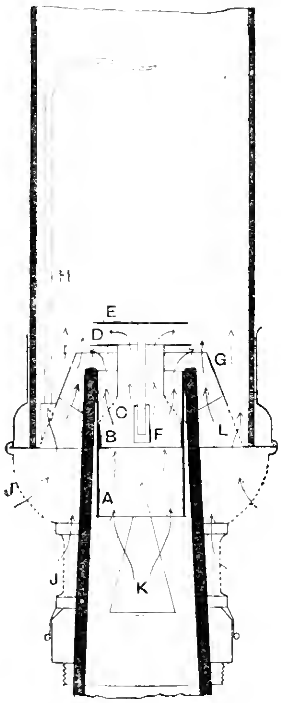
B. Degree.	*Specific Gravity.*	*B. Degree.*	*Specific Gravity.*	*B. Degree.*	*Specific Gravity.*
10	1·	20	·936	44	·811
11	·993	24	·913	45	·807
12	·986	25	·907	48	·794
13	·980	28	·890	50	·785
14	·973	30	·880	52	·777
15	·967	32	·869	55	·764
16	·960	35	·854	56	·760
17	·954	36	·849	58	·753
18	·948	40	·830	60	·745
19	·942	42	·820		

Phosphorescent Paint.—Luminous paints require direct sunlight for some time, and the phosphorescence they display in the dark only lasts for a few hours. Luminous paints are usually made by heating oyster shells in the fire until they become white, and then placing them in a crucible with sulphur and melting. Another method is to mix thoroughly 100 parts chalk and 40 parts flowers of sulphur, and heat in a closed crucible until fumes cease to be evolved. Powder the residue of calcium sulphide, mix with the smallest possible quantity of gum water or glue size, and use it as a paint; it is said to be not so good if mixed with boiled oil or varnish. Luminous paints can also be made by using strontium carbonate in place of chalk.

Oxidising Steel and Silver.—To oxidise silver chains to a good dark colour, dip them in a solution of potassium sulphide 24 grains, sal-ammoniac 10 grains, water 1 pt. For steel chains, dip them in sodium hyposulphate 200 grains dissolved in water 1 pt., then rub with sand or a scratch-brush. Repeat till the desired colour is obtained.

Meaning of Term "Ampère-turn."—The term "ampere-turn" is applied to winding dynamos and electrical instruments. The magnetising effort of a coil carrying a steady electric current depends on the product of the number of the complete turns or loops in the coil and the current in ampere-s, and the magnetic effect thus produced is measured in ampere-turns. Of course, the coil is supposed to be wound so that the magnetic effect of the turns is in one direction. Thus, if a coil of sixty complete turns carries a current of 5 ampères, the magnetic effect of the coil is $60 \times 5 = 300$ ampere-turns.

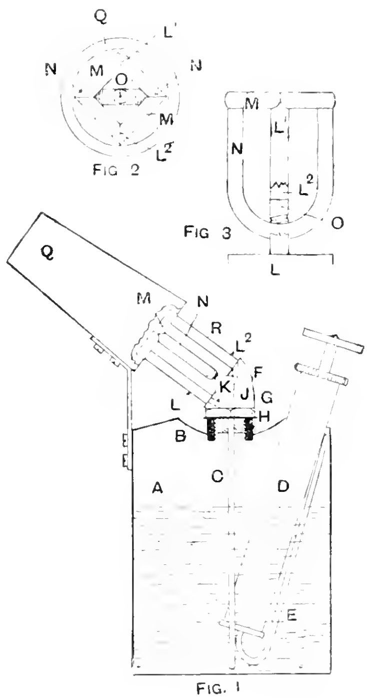
Incandescent Burner for Oil.—The accompanying sketch shows an ordinary central draught oil lamp argand burner adapted for use with a mantle. It is so designed that the entire outside, including mantle and chimney, lifts off for lighting and trimming, and leaves the wick-tube standing clear. This is not absolutely essential, but it lessens the risk of damaging the mantle. The tube A fits into the wick-tube as shown, and can be removed if a mantle is not available, and carries with it all the special fittings. Another tube B is attached to A, contracted, and perforated at C. On the top a flange D is fixed. Inside B a socket F is fixed to support the disc or "spreader" E. A cone G is attached to the removable part of the burner, from which the wire H rises to support the mantle. When the wick is lighted, and raised about halfway between the top of the wick-tube and flange D, air enters through the triangular space K (always present in a burner with a conical wick-tube). Part of the air current goes through the perforations C in B and is slowed down by so doing. It is directed against the inside surface and edge of the wick, and develops from the wick the gas of combustion. A rapid current of air enters through perforations J, and rises between cone G and the wick-tube, and carries the flame up from the outside and outer edge of the wick, whereby a blue flame of intense heat is produced. Another current of air rises in the centre of the burner and issues laterally between flange D and spreader E. This causes a whirling or eddying motion of the air and the vapour of the oil, ensuring thorough mixture and freedom from soot and smell. It also causes the flame to rise in the form of a long cone, completely enveloping the mantle. Yet another air-current rises through the perforations L and keeps the flame away from the chimney. The air-currents are indicated by arrows without letters appended. A cone outside G, and somewhat higher, may be added, over which the end of the mantle will slip, and thus will be held steady whilst the lamp is moved about. The wick winder is not shown. Some experiment will be necessary to get the right proportions between the air-currents.



Incandescent Burner for Oil.

Fastening Range Tap.—To fasten a brass tap that has become loose in a kitchener, the nut on the tail of the tap inside the boiler must be loosened and removed and fresh packing material put around the tail before replacing the nut. The usual packing is a ring of hemp, called a "grummet," which has a mixture of red and white lead worked into it, and this, when compressed by the tightened nut, makes a sound joint which soon hardens. Leather should not be used, but a collar cut out of sheet indiarubber will make an excellent and clean joint quickly prepared. The hole in the rubber over the tail of the cock (inside the boiler) should be a close fit.

Making a Paraffin Blow-lamp.—The paraffin blow-lamp here shown is used for removing paint from doors, etc. The reservoir A is made of thick sheet brass strongly soldered. It has a hollow B in the top, in the centre of which the burner is screwed, an asbestos washer making all air-tight. A pipe C, about ¼ in. bore, is soldered into the burner, and reaches nearly to the bottom of the reservoir. An air-pump D is soldered or screwed into the reservoir, so as to permit the burner to be screwed in, and a piece of small tube E conveys the air from the pump to the top of the reservoir. The burner consists of a solid brass casting F, the bottom part of which is formed into a hexagon G to fit the spanner, and a screw is cut to fit the screw collar H. A hole is drilled to meet the tube C, as shown by dotted lines at J, and another hole is drilled at K so as to run into J. Two short pieces of tube L^1 and L^2, about ¼ in.,



Making a Paraffin Blow-lamp.

are soldered on so as to cover up the holes in F. A piece of tube M, mitred as shown (Fig. 2), is soldered to L^1 and L^2, the dotted lines showing the position, and another piece of tube, U-shaped (N, Fig. 3), is soldered to M. A nipple O, with a very fine hole in it, is screwed into N, the tube having another piece of metal soldered to it to provide thickness for the screw thread. On working the pump, the space in the reservoir above the oil will be filled with compressed air, which will force the oil up C, through J and K into L^1 and L^2, round M, then into N, and out of the nipple O. Some of the oil is allowed to run into the hollow B, and is lighted. As soon as the burner gets hot enough to gasify the oil in the tubes the gas will issue from the nipple with a roar, ignite, and, as it passes through the centre of M, will turn the oil therein into gas, and so become self-acting. A nozzle or tube Q is attached as shown to concentrate the flame, and a handle and screw cap for filling must be added. A small air-tight tap must be soldered in the top of the reservoir so as to let the air escape when the lamp is done with. Experiment will show how much oil is wanted. If the flame is too large for general use, or if the burner gets choked by too much oil, the tube C can be pinched in a little at the bottom, or by making F a little taller a tap might be arranged for. Brass and hard solder must be used throughout.

Cleaning Floor Tiles. For cleaning glazed terra-cotta floor tiles, a rub with a dry or slightly damped flannel is all that is necessary. Unglazed floor tiles occasionally present a white scum on the surface, caused by the evaporation of the lime and cement used in the foundations. In cases where the tiles have been laid on new foundations, this scum may continue appearing for some months. The floor is not injured by this, and the scum may be easily removed. Floor tiling should be cleaned two or three times a week with soft soap dissolved in tepid water and applied with a hand scrubbing-brush. Paint spots or similar stains, and also cement marks, may be removed by pouring on them a small quantity of sulphuric acid diluted with an equal quantity of water and allowing it to remain for a few hours. It should then be washed off and, if necessary, again applied till the stain has disappeared. For removing ink stains, use nitrous acid in place of sulphuric acid. Particular care should be taken when using these acids, as they will burn both hands and clothes. A piece of old flannel may be used for washing the acid from the tiling.

Preventing Knots showing through White Enamel.—White-enamelled articles made of cheap wood show the knots and dark parts of the grain. To prevent this, dissolve 2 oz. of pale shellac in ½ pt. of methylated spirit, then mix in some finely crushed flake white. Apply this solution to the knots, etc., with a camel-hair brush; several coats may be laid on so long as the solution is evenly distributed. Any harsh edges must be smoothed down with fine glasspaper before applying the enamel, which should not be used too thin.

Fixing Cylinder Pivots in Watch.—The cylinder of a horizontal watch is composed of a thin, polished steel tube open at each end. Into the open ends plugs are fitted, and the pivot is formed by turning the plug end smaller, and is therefore solid with the plug. When a pivot is broken, the plug is knocked out with a special punch shaped as shown below, a new one fitted, and the pivot turned and polished to fit the jewel hole. In knocking out the plug, rest the cylinder on a stake with

Punch for Removing Cylinder Plugs.

graduated holes in it. Let the brass collet rest on the stake and gently tap the punch. In most cases the plug comes out easily; but sometimes the brass collet will shift first, especially when the plug is very tight. In such a case, to start the plug use a stake with coned holes, and when once started the plain hole stake can be used; select a hole which exactly fits the plug and that will not let the cylinder body come through. To turn the pivot, warm the cylinder gently on a brass plate or over a flame and run it full of shellac; this makes it solid and firm to turn and prevents breakage. Also, if turns are used, fix a turning ferrule on by means of shellac. If a lathe is used, cement the cylinder in an ordinary wax chuck having a coned hole into which the bottom pivot of the cylinder is firmly pressed, and it is run true in the lathe while the cement is warm by means of a pointed watch peg.

Preparing a Signboard for Gilding upon.—The board should be well rubbed down with a flat piece of pumice-stone and plenty of water to efface any old writing and also to get a level surface. The rubbing should be done lightly with a circular motion. Should the stone clog, free it by rubbing two pieces together; wash off with clean water and allow to dry. For the first coat of paint, beat up ½ lb. of genuine white lead in turps, add ¼ lb. of drop black, and thin to the consistency of cream with good carriage varnish and turps; this will make a dark lead colour. Lay on evenly with a ¾ ground hog-hair brush. The mouldings may be done with a medium size sash-tool. When thoroughly dry, the board should be lightly glasspapered with fine paper; then dust off and give a coat of all drop black ground in turps thinned with varnish; allow time to dry hard, and give the final coat, which should be quite flat, made from drop black ground in turps with just enough varnish to bind the colour. This last coat should dry off without gloss. The gilding can then be proceeded with.

Hard-soldering Gold Rings.—For hard-soldering a gold ring without discolouring it, use solders containing gold, which is afterwards brought to the surface by a process of annealing and pickling. The solders are prepared to suit the quality of the gold to be soldered, so that they may "colour" well and thus hide the joint. The following is a list of coloured solders:—Best solder: fine gold, 12½ parts; fine silver, 4½ parts; copper, 3 parts. Medium: fine gold, 10 parts; fine silver, 6 parts; copper, 4 parts. Common: fine gold, 8½ parts; fine silver, 6½ parts; copper, 5 parts. The solder is cast in long ingots, rolled thin and flat, and cut up, or filed into dust, and thus applied to the cleaned joints, using borax as a flux. After the joint has been closed under a blowpipe flame, the whole ring is annealed on an annealing plate to a dull red heat, then cooled, pickled in acid, and polished. The film of grease left on by the polishing process is washed off in hot soda water, and the ring dried in hot sawdust. Hard-soldered rings may be coloured with a film of electro-deposited gold.

Bleaching Bone Grease.—Bone grease may be bleached by adding sulphuric acid and then thoroughly washing in water. Use two tanks, lined with lead, one above the other, and fitted with agitating gear; the lower tank should be fitted with a perforated steam coil. The melted grease is first run into the upper tank, and for each 10 gal. 1 lb. to 1½ lb. of strong sulphuric acid is added, and quickly agitated with the grease for about half an hour. The grease is then run into the lower tank, in which it is thoroughly washed with several lots of hot water and steamed. After settling, to further clear it the purified grease may be run off into a tank kept in a warm place, or the grease may be run into barrels if the presence of a small quantity of water is not detrimental.

Boehm System of Fingering for Oboe and Clarionette.—The Boehm system of fingering, which was introduced about 1846, consists in making the keys (which formerly closed by springs) open automatically, the closing being effected by means of rings round the finger holes. By adopting this device, holes can be bored in more correct positions, and the fingers are not strained by stretching. Bass fingered wood-wind instruments are also made possible. Even in the flute the holes are very far from being in their best position. In the accompanying illustration of a flute it will be seen that the lowest finger hole is too high; if it were in its right place it would be too far for the third finger to close it, therefore

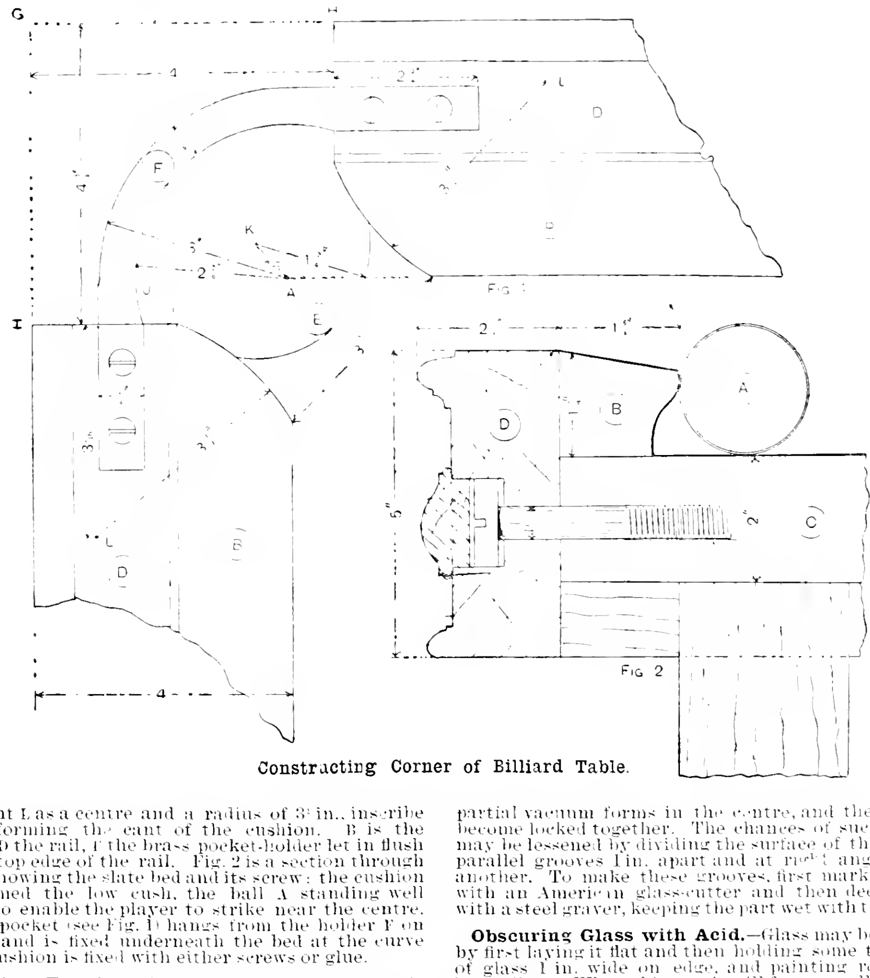
System of Fingering Flute.

it is brought nearer, and made smaller, the result being that what is gained in convenience is lost in tone. Siccama therefore made his flutes with open keys for this and the corresponding hole on the middle joint, closing them by leverage, which is brought to an easy position for both of the third fingers. Another advantage of the Boehm system is the better manipulation of the fingerings, by which the alternate opening and closing of the holes work the keys which produce the chromatic sounds. In the one-keyed flute, nearly all these sounds must be produced in this way; and even when keys are provided it is sometimes easier to use the fork or cross fingerings. Thus, let 1, 2, 3 represent the right-hand fingers, and all closed holes represent D, 1 and 2 closed E, 1 closed F sharp; the fork for F natural would be 1, 3 closed, 2 open. Now if hole 2 is bored, so that with hole 3 open it makes a good F sharp, it by no means follows that the closing of 3 will enable the open hole 2 to produce a true F natural. By the use of a small auxiliary hole, and rings round 2 and 3, both sounds can be made perfect. If the Boehm system could have been adopted in its entirety, self-closing keys would have been superseded by self-opening keys; but that being found impracticable, the system has been modified, and is partially applied to very many instruments, one of the most advantageous being Barre's improvements for oboes and clarionets. It is really a combination of old and new systems, whereby a lever allows the self-opening keys to act, while they are closed by rings round the proper holes when they must be shut.

Solution for Electro-Silvering.—To make a good silvering solution, procure 2 oz. of the best crystallised silver nitrate and dissolve it in 1 qt. of distilled water. Also procure 2 oz. of best potassium cyanide and dissolve it in 1 pt. of distilled water. Add this a little at a time to the silver nitrate solution, and stir well each time with a glass rod until no white curdy precipitate is caused by the addition of a few drops. Allow the white curds to well settle down, then pour off all the liquid. Pour on clean water, allow the curds to settle again, and repeat the process several times; finally, drain off as much of the water as possible. Dissolve these white curds in a solution of potassium cyanide and add a little surplus to make it work freely. Use anode plates of pure silver, and work cold in a stoneware or glass vessel with current from two Smee cells, or from two or three Daniell cells.

Making Portland Cement Wash.—To make a Portland cement wash of a light stone colour, first spread the cement dry on the floor for five or six hours, then well mix with water in a large tub. The consistency must be judged by the condition of the wall to which the wash is to be applied. To every 5 gal. add 1 qt. of soluble glass; keep well stirred when using. This will make a grey stone colour, but not that known in London as stone colour.

Constructing the Corner of a Billiard Table.—Fig. 1 shows the plan of the corner, the figured dimensions indicating how it is produced. The outer lines are at right angles, the inner lines are parallel with it, A being the intersecting point of the inner, and G of the outer. From point G mark off 1¾ in. on each outer line to H, and a line 2¼ in. long square with it to I. With point A as centre, and the radius AJ, inscribe the segment forming the inner edge of the pocket-holder F. With point K as a centre and a radius of 1¾ in., inscribe the segment E forming the corner.



Constructing Corner of Billiard Table.

With point L as a centre and a radius of 3¼ in., inscribe the arc forming the cant of the cushion. B is the cushion, D the rail, F the brass pocket-holder let in flush with the top edge of the rail. Fig. 2 is a section through the rail showing the slate bed and its screw; the cushion B is termed the low cush, the ball A standing well above it to enable the player to strike near the centre. The cord pocket (see Fig. 1) hangs from the holder F on one side and is fixed underneath the bed at the curve E. The cushion is fixed with either screws or glue.

Gas Fire Roaring. The roaring of a gas fire is generally due to some roughness in the interior of the burner, caused either by a burr in the tube or by an accumulation of deposit, the result of the burner firing back. This is often found to be a source of the trouble.

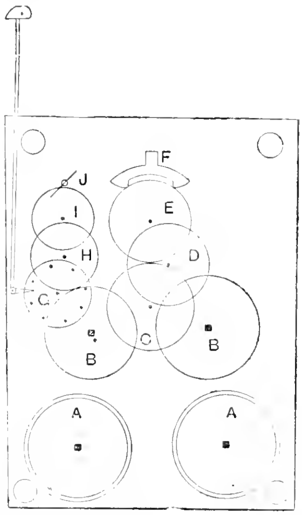
Speculum Grinding.—In rough grinding, use flour emery until all the pits left by the coarse grains are worked out. The surface of the speculum will then appear quite uniform when examined with a magnifying lens of about 1-in. focus. The fine grinding is then commenced. A good way of judging when the process of fine grinding is completed is to hold the speculum in such a position that a gas flame is seen by oblique reflection in it; then gradually increase the angle of incidence until the image grows dim. By slightly tilting the mirror the image may be made to pass over every part, and should appear equally though feebly illuminated in every position. Another method is to hold the mirror horizontally, about level with the eye; then, when looking along it at the window, no greyness should be visible. The glass is now ready for polishing. The more thoroughly the fine grinding is done, the less polishing will be necessary and the less injury will be done to the figure in the polishing. What is known as the shadow test is applied continually when figuring and polishing. Sometimes the speculum becomes tightly locked with the tool during the process of fine grinding, and this may be explained as follows:—As the upper disc moves along the lower one there is a tendency to heap up the emery towards the centre and away from the edges. This makes the convex tool slightly flat, and the concave speculum slightly hollow in the middle, thus leaving an empty space between them. After a time the film of moisture between them becomes exceedingly thin, a partial vacuum forms in the centre, and the two discs become locked together. The chances of such mishaps may be lessened by dividing the surface of the tool into parallel grooves 1 in. apart and at right angles to one another. To make these grooves, first mark them out with an American glass-cutter and then deepen them with a steel graver, keeping the part wet with turpentine.

Obscuring Glass with Acid.—Glass may be obscured by first laying it flat and then holding some thin strips of glass 1 in. wide on edge, and painting round with hot tallow. When this sets it will form a wall all round the glass, and keep in the acid; or paint a bank round the glass with two or three coats of hot tallow. Now pour on white acid, and let it remain until the glass is matted.

Bringing Watch to Time. To bring a watch "to time" means to make it keep correct time. To do so with a *good* watch, the curb pins must first be closed until the hairspring has no play between them. Then regulate by lengthening or shortening the hairspring, the regulator meanwhile being kept in the centre. Shortening the hairspring makes the watch go faster and *vice versa*. After each alteration of the hairspring, the watch must be set in beat afresh by turning the hairspring collet round a little.

Polishing and Cementing Alabaster.—After washing, melt a little white beeswax, dip a clean cloth in it, and polish the ornaments with the cloth. The best cement for mending alabaster is white gelatine size, made by melting 1 part of gelatine in about 5 parts of water. Plaster-of-Paris is very often used as a cement, but only in places where the joints would not be seen, and it is not a strong cement.

Making Eight-day Movement for a Lantern Clock.—The frame should be made of brass plates $\frac{1}{8}$ in. thick, and should measure $1\frac{1}{2}$ in. by 6 in. The pillars (four) must be $\frac{3}{8}$ in. diameter and $1\frac{3}{4}$ in. long between the plates. The barrels should be $1\frac{1}{2}$ in. diameter and $1\frac{1}{2}$ in. long. For going train, use fusee main wheel of 96 teeth, $1\frac{3}{4}$ in. diameter; centre wheel of 84 teeth, $1\frac{3}{4}$ in. diameter, pinion 8 leaves; third wheel of 78 teeth, $1\frac{3}{16}$ in. diameter, pinion 7 leaves; 'scape wheel of 40 teeth, $1\frac{1}{4}$ in. diameter, pinion 7 leaves. For motion work, use minute wheels of 36 teeth, $\frac{3}{4}$ in. diameter; hour wheel of 72 teeth, $1\frac{1}{4}$ in. diameter; minute pinion, 6 leaves. For striking train, use fusee main wheel of 84 teeth, $1\frac{3}{4}$ in. diameter; pin wheel of 64 teeth, $1\frac{3}{16}$ in. diameter (eight pins), pinion 8 leaves; pallet wheel of 70 teeth, 1 in. diameter, pinion 8 leaves; warning wheel of 60 teeth, $\frac{7}{8}$ in. diameter, pinion 7 leaves; and fly pinion, 7 leaves. Either chains or gut lines can be used, but chains are best. The fusees must be cut for sixteen complete turns of the chains. On account of the small size of the movement, it can carry a light hammer spring only. The pendulum will make 178 beats per minute, and will be of 4·3 in. acting length, which, with a 2-in. diameter brass bob, and allowing for suspension, will measure nearly 6 in. long over all, and just swing clear of the bottom of the case. The pendulum should be provided with the rating nut above the bob, after the usual pattern of English bracket clocks, and thus save the space occupied by a nut under the bob. The centre pinion, when made from pinion wire, is thickened at the front end by having the leaves at that part forged up solid. This method will be almost impossible in so small a clock as this, and if pinion wire be used, it would be advisable to drive on a steel collar to form the shoulder of the front pivot. In the accompanying sketch, A A are the barrels; B B, the fusees; C, centre wheel; D, third wheel; E, 'scape wheel; F, pallets; G, pin wheel; H, pallet wheel; I, warning wheel; and J, fly.

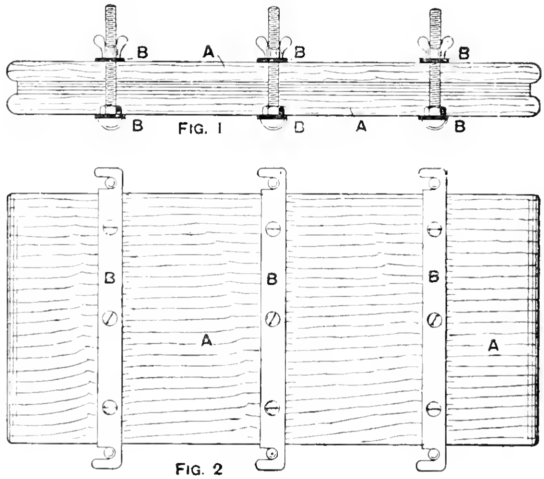


Eight-day Movement for a Lantern Clock.

Preparing Creosoted Timber for Painting.—Painters' knotting is a good material for coating creosoted poles and other wood previous to painting, because it dries quickly and tends to prevent oil or grease oozing through. The best kind of knotting will be that made from shellac; the commoner material will contain more or less common resin.

Solution for Electro-gilding.—For gilding small goods by the electro process, place a pint of distilled water in an enamelled iron saucepan and dissolve therein 1 oz. of best potassium cyanide. Heat this to 160° F. on a gas stove. Get two strips of pure gold and two lengths of No. 22 copper wire, and suspend the gold strips by the wires in the hot cyanide solution; then connect the wires to the battery and allow a full current to pass through the solution, from one gold strip to the other, for about two hours. Then take off that gold strip which is attached to the wire from the zinc of the battery, and substitute a strip of clean German silver. If this takes on a good coat of gold in a few seconds, the solution is in working order, and the two gold strips may then be both attached to the wire from the silver, copper, or carbon of the battery and used as anodes. If the coating is not satisfactory, dissolve some more of the gold as at first, until the solution will gild well. The same solution may be made at once by the direct process—that is, by dissolving $\frac{1}{4}$ oz. of gold cyanide in the hot cyanide of potassium solution. These gold solutions give good results when worked at a temperature of from 140° to 160° F., and will give a good coat of gold with current from one Smee cell when an anode (or dissolving plate) of pure gold is employed.

Making a Trousers Press.—Figs. 1 and 2 show elevation and plan respectively of a simple trousers press, A A being two flat boards 14 in. wide and about 30 in. long. Three iron bars B are screwed on each board. The bars on the top board are hooked at their extremities, as shown in Fig. 2, to allow the board to be removed without taking off the wing nuts. In Fig. 2 the wing-nuts are removed so as to show the slots. The bars on the under board are not hooked, but have holes at their extremities to receive coach bolts, which should be fixed with screw-nuts before the bars are fastened to the board. When the bars are fastened to the boards, the top board can be screwed down with wing-nuts. A sheet of thick cardboard should be placed between each pair of trousers before pressing them.



Trousers Press.

Golden Brown Paint for Castings.—To obtain a rich golden brown colour on castings, mix the colour with the best copal or carriage varnish, adding gold size. Paint the castings in the usual way, and then stove them. Or another method would be to paint them with the colour required rubbed up in oil and with gold size, and then varnish with best varnish.

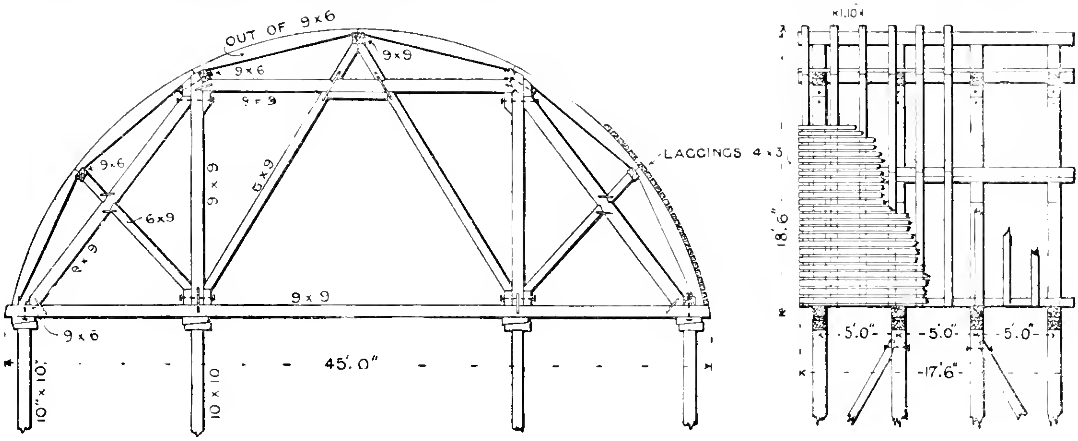
A Bucket as a Photographic Print Washer.—To make a cheap syphon washer that will keep photographic prints in circular motion, to one side of a bucket solder a syphon of ordinary lead piping, the short leg inside being 1 in. above the bottom. At the top of the syphon punch a hole and fit a cork. Fix in a circular sheet of perforated zinc inside the bucket 3 in. from the bottom. At the top of the bucket opposite the syphon attach another pipe, connected with the ordinary water tap by rubber tubing, through which the water flows. This keeps the prints moving. The contaminated water falls below the perforated disc and is removed by the syphon. When the cork of the syphon is in, the washer will run dry, but in use the cork should be removed, so that, in the event of any obstruction or failure of the water supply, the washer will remain filled level with the cork-hole. The edges of the zinc must be bent downwards, as there must be no sharp edges to come in contact with the prints.

Hard Woods and Soft Woods Classified.—It is customary in England to speak of all timber obtained from coniferous trees as "soft wood." Pitch pine is, of course, much harder than a number of the so-called "hard woods," but it would nevertheless be classified as a "soft wood." Much better is the system adopted in some parts of America, where four grades of hardness or softness are recognised namely: "Very hard woods," "hard woods," "middling hard woods," and "soft woods." The names of a few familiar woods will illustrate its application:—

V. H. Woods.	*Hard Woods.*	*M. H. Woods.*	*Soft Woods.*
Hickory.	Ash.	Pitch pine.	Pine and fir.
Hard maple.	Black walnut.	Douglas fir.	Redwood.
Locust.	Beech.	Larch.	Poplar.
Best oak and elm.	Oak and elm.	Sweet gum.	Whitewood.
Persimmon.	Lacewood.	Light birch.	Cypress.

The classification is arrived at by the amount of power required to indent a square inch of the surface of the wood to a given depth.

Centering for Brick Arch.—A figured design of a centre for a seven-ring brick arch of 45ft. span and 18ft. 6in. rise, the length of the arch being 17ft. 6in., is here given. It is assumed that the centering has only



Centering for Brick Arch.

to carry the arch bricks. It should be very carefully put together, as there is no surplus strength in an arch of these dimensions.

Refining Impure Tin.—In refining impure tin, melt the metal, well stir it about while in a molten state, and allow it to settle down for a while. Skim the dross from the surface, and remove the top half of the molten metal with a small ladle, disturbing the lower part of the metal as little as possible; use only the part of the metal removed for the best work.

Tinning Copper Moulds.—A bright, smooth, but very thin deposit of tin upon the interior of an ornamental mould may be obtained by first thoroughly cleaning the mould, then placing the open end upwards in boiling water and fastening it so that the edges are not quite immersed. In sufficient water to just fill the mould dissolve about an ounce of cream of tartar. Melt some tin in a ladle and pour it into cold water, so as to obtain it in spongy fragments. Place some of these in the cream of tartar solution, then pour the mixture into the mould. Boil the water in which the mould is placed for about an hour; the interior will then be found to have received a fine silvery, though thin, deposit of tin. Probably a bright, smooth surface and thicker coating could be obtained by first tinning the mould by the regular process, and afterwards standing it bottom downwards in Russian tallow, which is kept heated to a temperature a little above the melting point of tin; the tin would then probably melt and run smoothly over the tinned surface (in the same way that it does upon tinned iron plates), and leave a surface for polishing of a similar character.

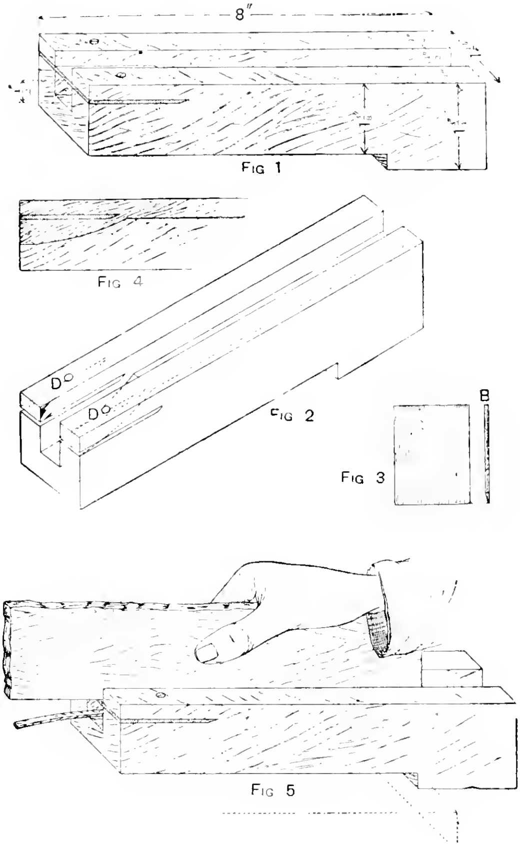
Petersburg Standard of Timber.—A Petersburg standard is 120/12ft. × 11in. × 1½in. = 165ft. cube. To ascertain the number of feet run of any sized scantling required to make a standard, multiply 1,440 by 16·5, and divide the product by the sectional area in square inches of the required scantling, the quotient being the number of feet. Taking 9in. × 2in. as example: (9 × 2 = 18). Then 1,440 × 16·5 ÷ 18 = 1,320. The following table includes the most general sizes; others can be worked out as above:—

Size.	*Foot Run.*	*Size.*	*Foot Run.*
4 × 2	2,970	4 × 2½	2,376
4 × 3	1,980	4½ × 2	2,640
5 × 2	2,376	5 × 2½	1,900⅘
5½ × 2	2,160	6 × 2	1,980
6½ × 2	1,827 9/13	7 × 2	1,697 1/7
7 × 2½	1,357 5/7	7 × 3	1,131 3/7
8 × 2	1,485	8 × 3	990
9 × 2	1,320	9 × 3	880
9 × 4	660	10 × 2	1,188
10 × 3	792	11 × 2	1,080
11 × 2½	864	11 × 3	720

Intensifying Photographic Negatives.—Dulness in a photographic negative is generally due to fog, caused by over-exposure, incorrect development (*i.e.* using too much No. 2), or accidental exposure to light. If the negative is fairly transparent, soak it in water for a few minutes, and then immerse it in a saturated solution of bichloride of mercury until it begins to bleach to a cream colour. Wash for fifteen minutes, and then place in a clean dish, film up, and pour over it a solution composed of 2oz. of water and thirty minims or drops of strongest liquor ammonia. The negative will instantly turn black (or it should be allowed to remain until it does). This operation is called intensifying; it increases the density and contrast of the negative. As the ammonia solution in careless hands is liable to produce stains, due to insufficient washings, some people prefer to use a saturated solution of sulphite of soda, with which very little washing is required between bleaching and blackening; but the density obtained is much less, partly owing to the blue colour of the deposit. Allowance for this should be made by bleaching thoroughly. The following formula may also be used after thorough washing, and gives a red image of great contrast:—Uranium nitrate 100gr., potassium ferricyanide 100gr., acetic acid ½oz., water 10oz. Rinse only and dry. Wetting the negative, pressing it between blotting-paper to absorb surface moisture, immersing in methylated spirit for ten minutes, and then drying by gentle heat, clears the shadows and gives greater contrast. Of course, if the dulness arises from a want of sharpness, the above is of no service, and the only remaining plan is to work over it with the retouching pencil, but this is a long and tedious process in most cases.

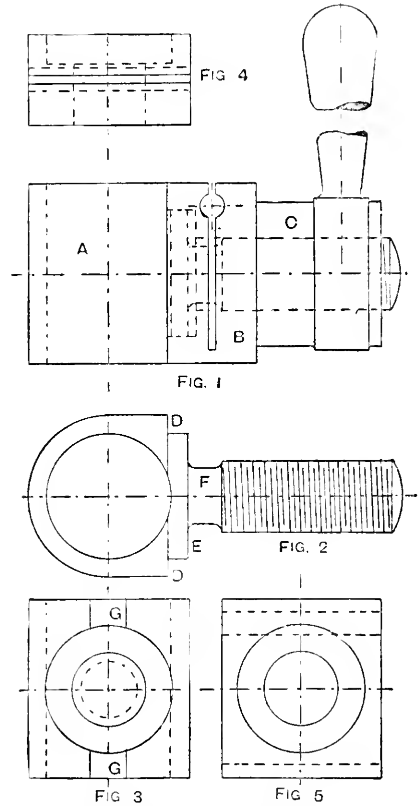
Cleaning Copper Utensils after Tinning.—It is doubtful whether there is any solution that would cleanse both the copper and tin from the dirt left from the tinning process without injuring either metal. The usual method of cleansing tinned copper vessels is to thoroughly scour them inside and out with sand and water or with any fine gritty substance until the whole of the surface is rendered clean, then rinse in cold water and dry the article in sawdust.

Making a Spill Cutter.—To make the spill cutter here described and according to the dimensions given in Fig. 1, a piece of wood some 8 in. by $1\frac{1}{2}$ in. by $1\frac{3}{4}$ in. must be obtained, and a groove about [illegible] in. wide and $\frac{3}{8}$ in. deep cut along the centre of one of its broad sides. At one end this groove is further hollowed out as in Fig. 2, which shows the shape of the groove and also illustrates the slits, 2 in. long, in which the knife is to be fixed. Now cut from the bottom a strip of wood some 6 in. long and $\frac{3}{8}$ in. thick, so as to leave a piece projecting from the under side at the rear end as shown in Figs. 1, 2, and 5. The knife itself is a piece of steel 2 in. long and $1\frac{1}{2}$ in. wide, into the sides of which two holes have been drilled as indicated in Fig. 3. The edge (see side elevation B, Fig. 3) is ground sharp just like a chisel, after which the knife is placed in the slits previously cut in the block. Then find the correct positions for the holes D D (Fig. 2) in the wood, through which pass the screws which hold the knife securely in its place. At Fig. 4 is given a section which illustrates the position of the knife, the cutting edge of which is raised about [illegible] in. above the bed of the groove. The cutter, being finished, may be put to work. First place the projecting under piece against the edge of the table, as shown in Fig. 5. A piece of straight-grained wood being pushed sharply forward through the groove, its bottom edge strikes against the slightly raised blade, and a spill issues from the aperture beneath the knife. By means of such a tool, spill making becomes astonishingly easy, and a large number can readily be cut in a very short time.



A Handy Spill Cutter.

Clip for Engineers' Scribing Block.—The accompanying illustrations show a form of scribing block clip greatly in favour a few years ago, simply because turning, rather than fitting, was principally required. Fig. 1 shows the clip complete in elevation. It consists essentially of three pieces, the clip itself A, the square washer B, and the handle C. The clip is shown in plan by Fig. 2, and in end elevation by Fig. 3. It may be made from square steel, drilled with a twist drill at one end to fit the post, this end, the left in Figs. 1 and 2, being rounded off to suit. The sides of these holes having been faced on a mandril in the lathe, these edges can be placed on any true surface, and centre lines scribed across at the ends. Or the piece can be placed on a mandril, and, the rounded end being centred, the ends of the mandril resting in V-blocks, the point of a knife tool is set to the mark, the tool withdrawn by the bottom slide only, the piece turned round, and the point of the tool moved up to mark the other end. The top slide must not be moved in these operations. Of course, the ends should have been prepared for scribing previously by filing and chalking. This method will ensure that the turned and threaded part shall be square with the hole, the mandril and a packing piece under the shank end being used in drawing the cross centre lines. The rest of the work presents no difficulty, but the face at D (Fig. 2) should be turned back just past the hole, a collar being formed at E. The turning down of the shank at F is for ease in chasing the thread. G (Fig. 3) shows the slots left by the turning back at D (Fig. 2). Fig. 4 is a plan, and Fig. 5 an end elevation of the washer. The outer surface of this corresponds with the shape of the large end of the clip, and a recessed hole is bored in it, the larger end fitting on the collar E (Fig. 2), while the small hole slides over the threaded end of the clip. The washer is slit down the centre nearly but not quite to the bottom, a hole for the scriber having previously been drilled across as shown at the top of Fig. 1. The handle C (Fig. 1) is threaded to fit the screwed end of the clip. The cross section of the boss and of the handle itself is circular. The washer also may be circular instead of rectangular, and will then work easier on the post.

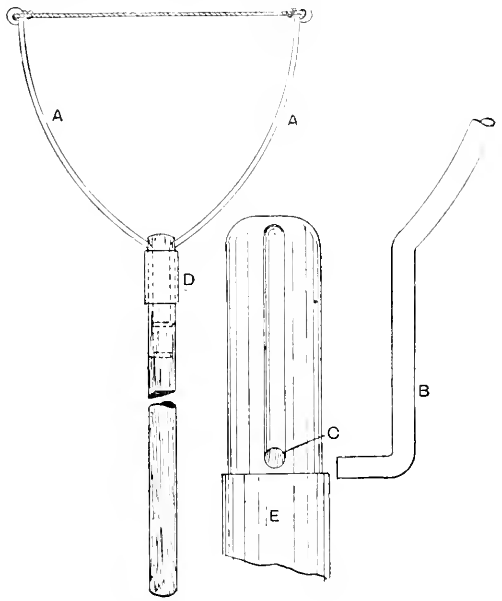


Clip for Engineers' Scribing Block.

Cementing Amber Mouthpiece.—When a broken amber mouthpiece of a tobacco pipe requires to be jointed, touch the broken parts with boiled linseed oil, and hold them for a few minutes in a gas flame; place them together, and bind with wire. Lay aside for a few days for the cement to harden, and pare off the excess with a sharp knife.

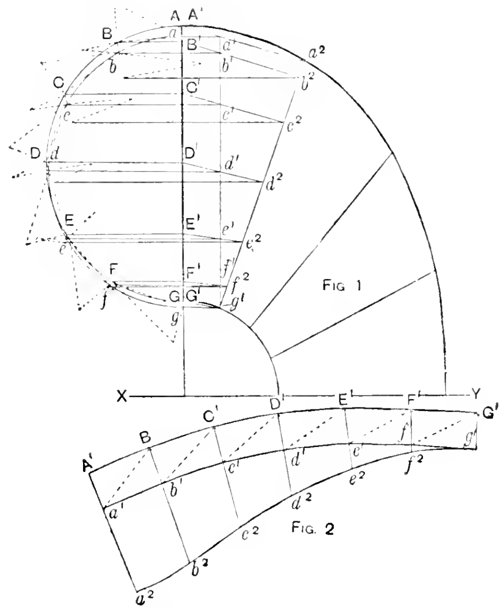
Giving an Ivory Appearance to Plaster Casts.—Over a slow fire melt lb. of beeswax with 1 pt. of turpentine, and apply to the plaster by means of a soft brush. Several successive coats are necessary to cover the plaster well. If the mixture is too thick, add a little more turpentine. Plaster casts may be coloured by including a tint in the wax and turpentine.

Making a Fisherman's Landing Net.—The illustrations show a simple frame for a landing net as used by anglers. The two side pieces A A are made of No. 7 B.W.G. steel wire, the outer ends being turned to form an eye. The ends that fit on the stick are bent at right angles for ½ in., as shown at B. One of these should be longer than the other, as they would weaken the stick if they came opposite. A hole C is bored on each side to take the turned ends of the wires, and the stick is grooved so that each wire will fit in flush. A cord is stretched across between the two eyes, and this completes a D-shaped bow on which the net is threaded. To hold the frame on the stick, a loose ferrule D is slipped up, or a lashing may be used instead if preferred. To take the net to pieces, the ferrule is slipped back to the position shown at E, when the wires may be removed and the net rolled round them. The stick may be made of greenheart or hickory.



Making a Fisherman's Landing Net

Pattern for a Ship's Ventilator.—To cut the pattern for a ship's ventilator in four pieces, first draw a side elevation of the required size, then divide the throat curve into a number of equal parts, corresponding to the number of sections required for the ventilator. Next divide the top curve, forming the top of the ventilator into the same number of equal parts used for the throat, and also draw the semicircle A G (Fig. 1). Join the division points on the throat and top curve by straight lines; these would show the four sections whose patterns are to be developed. As the method of working would be the same for each section, the method adopted for the section A G, $a^2 g^1$ (whose half-pattern is shown by Fig. 2), could be applied for developing the remaining three sections. A very near approximation to an accurate pattern is obtained by assuming that each section is a part of an oblique cone, and if this be done, the semicircle A G (Fig. 1) would be the half-plan of the base of an oblique cone containing the first section. Now join A a^2 and $G^1 g^1$, and also draw a line from g^1 parallel to A G to cut A a^2; then this line could be assumed to show the smaller end of the frustum of the cone on the elevation. Draw projectors from a^1 g^1 to join A G, and with half this length as radius draw the semicircle a g to show the plan of the small end. Next divide the semicircles into a similar number of equal parts as A, B, C, a, b, c, etc. From the division points B, C, D, E, F draw projectors to A G^1, and from b, c, d, e, f draw projectors to join $a^1 g^1$. Join $B^1 b^1$, $C^1 c^1$, $D^1 d^1$, $E^1 e^1$, $F^1 f^1$, and produce these lines to join $a^1 g^1$ at b^2, c^2, d^2, e^2, f^2. Join the division points on the plan by straight lines, and from b^2, c^2, d^2, e^2, f^2 draw projectors to join the lines with corresponding letters on the plan, and if a curve were drawn through the points found, that curve would show the plan of the section of the ventilator on the line $a^2 g^1$. Join the division points a B, B c, C d, D e, E f, F g by a series of dotted lines, as shown, and these would be the plans of a series of diagonals joining the points indicated. Next find the true slants of the stripes and diagonals by drawing lines at right angles to B b, C c, D d, E e, F f, and on the lines drawn at right angles mark the upright height $g g^1$, as shown. Join the division points on the inner circle to the points marking the upright height, and this would form a series of triangles; the slant length forming one side of the triangle would be the true slant of the line on the cone in each case. Next find the true slants of the dotted diagonals by the same method, using the same upright height as for the slants. The hypotenuse of the triangle formed in each case would be the true slant of the diagonal. To find the true slants of the lines above $a^1 g^1$, where the projectors



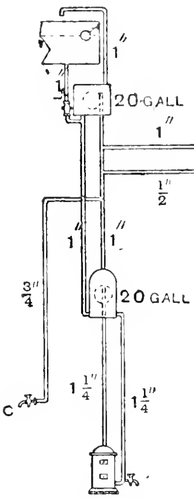
Pattern for a Ship's Ventilator.

drawn from b^2, c^2, d^2, e^2, f^2 join the lines with corresponding letters in plan; draw lines from the points found at right angles to the plan lines, and on these lines mark off the perpendicular height of b^2, c^2, d^2, e^2, f^2 when measured from the line $a^1 g^1$. Now join b, c, d, e, f to their respective upright heights, marked on each right angle to obtain the true slants of the lines produced to cut $a^2 g^1$. To work the pattern, mark on a straight line the length $A^1 a^1$ (Fig. 1). With the true length of the diagonal joining a to B as radius, and using a^1 (Fig. 2) as centre, draw an arc; with the division length A B as radius and A^1 (Fig. 2) as centre, cut the arc first drawn. Next, with the true slant of the line B b as radius, and using B^1 on the pattern as centre, draw an arc. With the division length a b as radius, and a^1 on the pattern as centre, cut the arc last drawn at b^1; this would give the points A^1 a^1, B^1 b^1 on the pattern. The remaining points are obtained by repeating the working for each division, using the slants and diagonals in their proper order for obtaining the points C^1 c^1, D^1 d^1, E^1 e^1, f^1 F^1 to complete the top part of the pattern. Join the points A^1 a^1, B^1 b^1, etc., on the pattern by straight lines, and produce them below the inner curve, then add the length a^1 a^2 (Fig. 1) from a^1 to a^2 on the pattern. Transfer the true slant of the line b^1 b^2 (obtained from the triangle drawn on the plan) to the pattern, marking from b^1 to give the point b^2; transfer the remaining true slants to the stripes with corresponding letters on the pattern, and draw a curve through these points to finish the half pattern for one section. By repeating the method of working shown for each section, the pattern for the complete ventilator would be obtained. Allowances for hollowing, seams, etc., must be made to the pattern as shown.

Amount of Rainfall on Roofs.—In estimating the size of gutters on internal roofs and behind parapet, the amount of rainfall should be provided for. An exceptional rainfall is about ·05 in per minute, and this gives about ·026 gal. for each square foot of catching surface. An average rainfall in London would be about one-third of the above, but for preventing gutters on internal roofs, or behind parapet walls, overflowing inside the house, the maximum should be allowed for.

Quantities of Cement and Slag in Concrete.—The amount of cement and slag required for laying 100 super. yd. of floor, 1 in. thick, in the proportion of 1 to 1, is as follows:—The cubic contents of the concrete when laid will be 900 super. ft. × $\frac{1}{12}$ ft. = 75 cub. ft. There will be required about 2 cub. yd. of slag, broken small enough to pass through a $\frac{3}{4}$-in. ring, and 54 cub. ft. of cement (at 90 lb. to the cubic foot) = 45 cwt. This 108 cub. ft. of cement and slag will shrink to about 75 ft. when mixed and wetted.

Cylinder-tank System Hot-water Supply.—In the sketch, A indicates the bath tap, B that for the lavatory, and C that for the scullery. The sketch shows a well designed and proportioned apparatus on the cylinder-tank system. The boiler (dome-top kind) should be a No. 3. A smaller size would do, but small boilers do not take a sufficient charge of fuel, and they therefore need more frequent feeding and attention than large boilers. If hard water is used, the boiler should have the water-way carried below the fire-bars, and be provided with cleaning holes and lids.



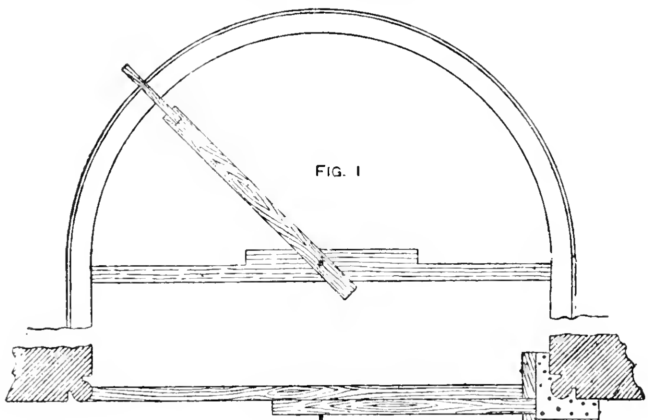
Cylinder-tank System Hot-water Supply.

Hints on Enamelling.—To treat white enamel to prevent it setting too quickly, it should be thinned with the same varnish as is used in making it. To enamel successfully, get a good flat ground to work upon, and do not try to improve the work by giving a second coat of enamel if the first does not turn out well. Never put a bright on a bright; the correct way is to finish a gloss on a flat, or a flat on a gloss. In the case of spoiled work, the work should be rubbed down with ground pumice-stone, flatted, and then enamelled again. Enamelling should be done in a warm room. All enamels become ropy if exposed to the air; keep well corked, therefore, and pour out for use only a small quantity at a time.

Painting a Staircase Wall.—In repainting a staircase wall, representing about 120 sq. yd., to a shade of green, if the colour, etc., is procured from a colour merchant (not an oil shop) the quantities and the cost will be as follows:—24 lb. of white lead, cost 5s.; 2 lb. of patent dryers, cost 8d.; 1 lb. of deep lemon chrome, cost 1s.; 3 lb. of deep brunswick, cost 2s.; 2 oz. of drop black, cost 3d., all ground in oil; 3 qt. of linseed oil, cost 1s. 6d.; and 3 qt. of turpentine, cost 2s. The white lead, dryers, chrome, black, half the green, and 1 qt. of oil should be mixed well together, after which small quantities of the reserved green should be added until the desired shade is obtained. The paint should be mixed lighter than the sample, as it will dry darker. Divide the mixed colour into two equal parts. Thin one part with the oil so that it works freely, and spread on the wall evenly; twenty-four hours afterwards apply the remaining portion of the colour, thinning with turpentine so that it works freely and covers well. The time is an important item; if the interval is more or less than twenty-four hours the second coat will be sheary—that is, bright in some places and dull in others. If the last coat is stippled the result will be a better job. To stipple is to dab the surface all over with a flat brush; this takes out the brush marks. Commence at the top and work downwards. There may be a little colour left over.

Making Imitation Tortoiseshell.—A very good imitation of tortoiseshell can be made by colouring a portion of the pasty celluloid with a brown or yellow dye soluble in spirit (aniline colour), and then working the dough along with some nearly colourless celluloid. As the two are not properly amalgamated, streaks and patches of colour appear throughout. Considerable experience, however, is required.

Running Return Bead round an Arch.—To work a return bead round the arch shown by Fig. 1, a mould is prepared to the required shape, and fixed to a radius rod, as shown in Fig. 2. The flat part of the wall is roughed in, and the bead is run in coarse stuff by the aid of the mould, which also works a part of the soffit, the rest of which between the two beads is done with the floating rule. After all the work has been roughed in ready for the fining coat, the mould is readjusted so as to be in position to work the finished bead, which is usually done in Keene's cement. The part of the bead below the springing line is done by detaching the mould from the radius rod, and using it in the ordinary way; while in cheap work the bead round the arch is sometimes worked without the aid of the radius rod. The walls are then finished off, the bead is run, and the soffit of the arch completed as in roughing out.

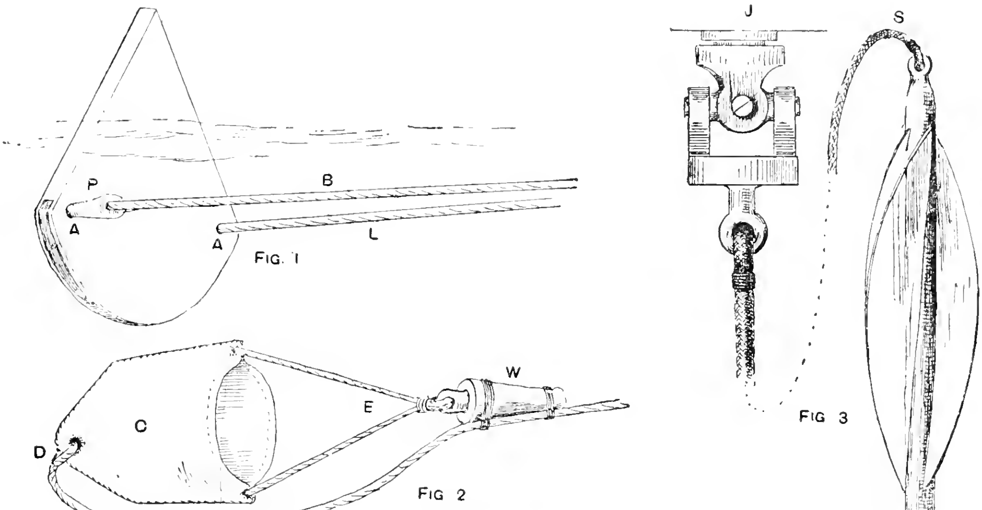


Running Return Bead round an Arch.

How to Copy a Glass Positive.—When copying a collodion positive mounted on glass and varnished at the back, the first proceeding is to remove the varnish. It may be possible to do this by placing for a short time in a dish of methylated spirit and then wiping down with a tuft of wool. Try one edge and see whether the picture is affected. When the varnish is removed, a print or transparency can be made by contact in the usual pressure frame. A better plan would be to pin the picture to the wall with drawing pins, and copy through the camera in the usual manner. To obtain a copy the same size as the original, it may be necessary to make a conical front, place two cameras together, or otherwise increase the extension, which should be twice the focal length of the lens. Copying is merely photographing a picture at close quarters. The only difficulty is to avoid the reflection of bright objects in the shadows and the picture. Slow plates should be used, and a strong pyro-soda developer.

Underglaze Colours for Biscuit Ware.—Underglaze colours are applied direct to the biscuit ware, and are therefore under the glaze that is applied after colouring. The coloured ware should be heated to the same temperature as in burning for biscuit, but the different colours may require different times, which will be found by experience. Time is not very important, however, as the colours are, to a large extent, fixed by a short heating, because they usually contain fusible materials.

Working a Ship's Log.—The speed of a ship is ascertained by the "patent log" or by a "log ship" and sand glass, the latter still being preferred by most sailing ship masters. The "log ship," two forms of which are given in Figs. 1 and 2, is hove over the weather quarter attached to the log line divided into "knots," a "knot" bearing the same proportion to a mile as the sand glass running in seconds does to an hour. Sand glasses, or "log glasses," are made to run 14 seconds and 28 seconds (the former being for use when fast travelling, and the knots by line have of course to be doubled if spaced for 28 seconds). It must be remembered a nautical mile is 2,027 yd., usually called 6,080 ft. It corresponds with the minutes of arc; thus there are 360 × 60 = 21,600′ of arc, or nautical miles, on a "great circle" (or the equator). The number of yards therefore in a "great circle" divided by 21,600 will give the number of yards in a nautical mile. In calculating the length of a knot in feet, the rule adopted is this. To the seconds run by the glass affix a cypher and divide by 6. The remainder when doubled gives the inches. Thus for a 28-second glass $\frac{280}{6} = 46 + 4$, or the distance between adjacent knots = 46 ft. 8 in. This is not correct, but the error is for safety, as the ship, unaffected by favourable currents, will be behind her position by log or "dead reckoning," as it is called. To calculate the exact length between adjacent



Working a Ship's Log.

knots on the line, multiply 2,027 by 14 or 28 and divide by 3,600. Fig. 1 is the wooden log ship; it is a wooden quadrant about ¼ in. thick and 10 in. diameter, the arc being weighted with lead to make the log float vertically. The end of the log line L passes through a hole and is secured by knotting at the back, while a wooden peg P is attached to a span B from the line L. When the log line is suddenly checked in its running out, this wooden peg withdraws its hold in the quadrant, and the log ship is hauled in with ease. The canvas log is shown in Fig. 2. The log line is attached at D to the canvas bag C, at the mouth of which is a span seized to the peg at E, which is pushed into a wooden ferrule W seized to the log line; when the line is checked the peg withdraws as in the former case, and the bag closes, being hauled in bottom foremost. The "patent log," by which name the several revolving logs go at sea, is self-registering, and not hove at intervals as the former kind. A meter is clamped to the taffrail, showing on its face by three hands the units, tens, and hundreds of nautical miles run since the last setting, which is done at noon. This meter is a simple train of wheels to which motion is imparted by a threaded pin. At the back of the meter and attached to the pin is a brass universal joint J (Fig. 3), to which is secured the end of a line sufficiently long to clear the eddies and backwash of propellers, etc. At the other end is the spinner S, a three-bladed brass fan, pitched to revolve at such a speed that after being towed one mile the unit hand on the meter shall have made one revolution from 0 to 0, the intermediates being marked ¼, ½, ¾. Sometimes a light fly-wheel is attached to the line just abaft the taffrail, but this is not really necessary. Ball bearings between a cone collar on the shaft and a dished bearing in the back of the meter would be an improvement. Owing to the length of flexible line through which the revolutions are transmitted, the motion is a succession of spurts, but this, however, does not affect the correctness of distance registered in the twenty-four hours.

Ingredients for Seltzogene Charges.—The charges for a 3-pt. seltzogene are tartaric acid 1 oz., and bicarbonate of soda 1½ oz. Any difference observable in the taste of the ready-charged syphons and of the water from the seltzogene using the charges purchased is probably due to the kind of water used, and also to the fact that a small quantity of carbonate of soda is added to the water in the syphons, whereas in the seltzogene there will be no soda in the water unless it be put in before filling the seltzogene.

Making Billiard Chalks.—To prepare green billiard chalks, mix together 5 parts of powdered magnesite and 1 part of china clay, and add 1 part of mineral green or terra verte; for a blue chalk, substitute 1 part of artificial ultramarine. Make the mixture into a very stiff dough with the least possible quantity of water, allow to stand for several days, roll it out into a cake of the thickness required, then cut it into squares with a fine wire; impress a hemispherical indentation on each square, then separate them and dry them very slowly—first in the air, then in a warm oven. If the squares are shaped in brass moulds the material should be made very stiff, almost dry in fact; the chalks will then be harder. If the chalks are too soft, add more china clay; the colour can be made to suit by trial.

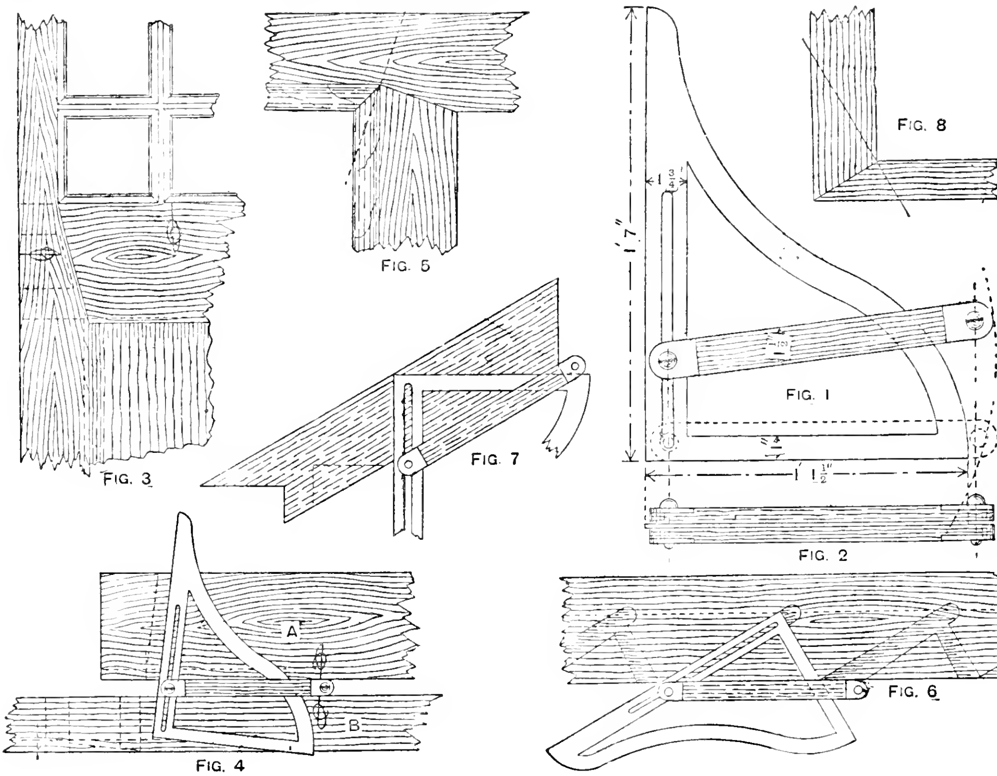
Renovating Old Oil Painting.—To restore to its original colour an old oil painting that is black with age and smoke, wash it with a sponge or soft leather and clean water, and dry with a silk cloth. If the painting is very dirty, take it out of the frame and lay over it a clean damp cloth. Allow the cloth to remain for a day or two, keeping it damp all the time. Then remove the cloth and place another clean damped one over the picture, and keep on renewing the cloths till the dirt is thoroughly soaked out of the painting, when it may be washed with a sponge and water. Then rub over the picture a little clear linseed oil, or give it a thin coat of mastic varnish applied with a clean flat brush till every part is covered, and set aside to dry where no dust will fall on it.

Converting Fat into Soap.—In converting a few pounds of fat into a good hard soap, dissolve 1 lb. of caustic soda in 3 pt. of water; then melt down 6 lb. of fat in an earthenware bowl. Bring the temperature of the fat to about 110° F., and the temperature of the soda lye to about 80° F. Now pour the soda lye very slowly into the centre of the fat and stir thoroughly with a stick, so that the lye becomes amalgamated with the fat as fast as it is poured in, and the two form a perfect emulsion. Now wet a large piece of cloth and place it in a box so that the whole of the wood is covered; then pour in the mixture just made, cover the box, and place it in a warm place for twenty-four hours. The soap is then ready to be cut up and used.

Cleaning White Marble.—To clean white marble that is much discoloured, make a thin paste with fuller's-earth and water to which has been added 25 per cent. of liquid ammonia. Spread this over the marble with a brush, allow it to remain twenty-four hours, then wash off. If all the stains are not removed, repeat the operation.

How to Make a Bevel Set-square.—Fig. 1 shows a side elevation of a carpenter's bevel set-square of suitable dimensions for setting out diminished stile doors constructed of plank widths; but a much smaller tool would be more handy for general purposes. The tool consists of two parts: a skeleton set-square made of steel or stout zinc, the former preferably, and an adjustable stock working in a slot which is about two-thirds the length of the long edge of the square. The stock is very similar to that of an ordinary bevel, except that it is in two parts which are connected at the ends by means of clamping set-screws, as shown in the end elevation (Fig. 2); it is applied. The tool can easily be changed into a perfectly true mitre square by fixing the stock at equal distances along both edges from the angle, or it can be used as an ordinary bevel. A wooden instrument based on the same principles is used by some joiners, but it is a clumsy article, and cannot be finely adjusted. The tool can be used as a set-square, or, by clamping down the stock in the position shown by dotted lines in Fig. 1, as a try-square.

Particulars of a 10-ft. 6-in. Split-cane Fishing-rod.—The handle of a split-cane fishing-rod, 10 ft. 6 in. long, which is to be made in three lengths, should be of cedar or walnut 16 in. long and 1¼ in. diameter at the largest part; butt, ½ in. diameter above the handle, tapering to fit a ferrule of ⅜-in. bone; total length of butt, 3 ft. 6 in. Second joint, ⅜ in. diameter at the counter, tapering to fit a ¼-in. ferrule at the top; total length, 3 ft. 6 in. Top, ¼ in. diameter at the counter, tapering to $\frac{1}{16}$ in. at the point; total length, 3 ft. 6 in. The number of pieces in each part will depend on the thickness of the cane; but the butt may be built up with six segments, each one made up of two thicknesses of cane, making twelve pieces in all. The second joint and the top should each be made with six pieces of cane. A good iron-faced plane, file, piece of glass, brace and bits, hammer, and glasspaper are the tools actually required.



How to Make a Bevel Set-square.

the tool can thus be adjusted to almost any position. Fig. 3 is a part elevation of a diminished stile door, shown in order to explain the application of the tool in setting-out the shoulders of the joint. This is shown in detail at Fig. 4. The dotted lines on the part A are the setting-out lines for the rail, and those on the part B are the setting-out lines for the stile. Figs. 3 and 4 should be compared. The rail and stile are shown separated in the sketch for the purpose of illustrating the method of using the square. Fig. 5 shows another joint where the tool can be applied with advantage. Fig. 6 shows the tool being used as a pitch-board; it can be worked from either edge of the string, and although it does not do away with the wooden pitch-board itself, no sliding slip is required, while its thinness and metal edges enable a much cleaner job to be made with the striking-knife. Fig. 7 shows the tool applied to roofing. A number of rafters can be laid side by side, and the length squared across them with a line at both ends. The stock of the square is then set to the pitch of the roof, and both bevels are obtained at once; no awkward moulds require to be lifted up and down, and both the bevels and the square are comprised in the same instrument. Fig. 8 shows a mitred joint of two different thicknesses of wood; the thick lines show the edges of the square when

Making an Enlarged Photographic Negative.—Any of the methods employed for making a bromide enlargement may also be used for making an enlarged negative, that is, by replacing the small negative by a positive transparency and enlarging this on to an ordinary dry plate. For cheapness, and with some subjects, bromide paper may be used for such transparency, developing rather dense with a strong but well-restrained developer, and, when dry, waxing the print and heating over a lamp. The best kind of transparency to use is one by the carbon process, as these are most free from grain and give the best gradation. As the emulsion used on dry plates is considerably quicker than that used for bromide paper, and is consequently more liable to fog, it is advisable to use an enlarging camera where the plate is enclosed in a slide. Enlargements are best made by daylight, otherwise there is a tendency to hardness.

Reproducing Photographs by the Half-tone Process.—Photographs are reproduced for printing by what is known as the half-tone process. Line blocks giving merely the outlines are produced in the same manner, except that no screen is used. Considerable plant is required to do the work thoroughly. A negative showing strong contrasts is taken on a photo-mechanical or wet collodion plate, a screen of sheet glass, ruled with a network of fine lines, being interposed between the lens and the plate. The screen usually contains about 120 crossed lines to the inch, but for work on fine surface paper 210 lines to the inch can be used. This screen breaks up the shadows into fine dots of varying size. A sheet of zinc coated with gelatine or fish glue, and sensitised with bichromate of potash, is then placed in contact with the negative. The parts exposed to light become insoluble in hot water, as in the carbon process. The unexposed parts are washed away, leaving the zinc bare between the dots. The plate is then immersed in nitric acid, which etches it or cuts into it. It is then mounted on a block of wood or metal to bring it level with the type.

Comparative Designs of Girders.—Assuming the load is 10 tons distributed over a span of 18 ft., the calculations will be as follows. (1) Flitch beam: $W = \frac{d^2}{L}(C\ b + 30\ t)$; where W = breaking weight in cwt. in centre; d = depth in inches: L = span in feet; C = constant = 3 for Memel; b = total breadth of timber in inches: t = thickness of flitch plate in inches. Factor of safety, 10. One or two trial designs may be necessary before finding a suitable one, when Fig. 1 may be decided upon. Ten tons distributed = 5 tons in centre multiplied by 10 for breaking weight = 50 tons = 1,000 cwt. Breaking weight $= \frac{14 \times 14}{18}(3 \times 14 + 30 \times 1\frac{3}{4}) = \frac{98}{9}(42 + 52\frac{1}{2}) = \frac{98 \times 94\frac{1}{2}}{9} = 1{,}029$, or a trifle in excess of the strength required. (2) Cast-iron girder: Depth, say, one-twelfth of the span = 18 in. Stress in bottom flange $\frac{W\ l}{8\ d} = \frac{10 \times 18}{8 \times 1.5} = 15$ tons. Allow $1\frac{1}{2}$ tons per square inch in tension: $\frac{15}{1.5} = 10$ sq. in. Make top flange same size to allow width for building upon and possible tension in top flange from ends being built in, so that the section will be as Fig. 2. (3) Wrought-iron plate girder: For the same depth the stress in bottom flange will be as found above = 15 tons. Allow 4 tons per square inch on the gross sectional area = $3\frac{3}{4}$ sq. in. Say, one $\frac{1}{2}$-in. plate 8 in. wide for each flange, with $2\frac{1}{2}$-in. by $2\frac{1}{2}$-in. by $\frac{5}{16}$-in. angle irons, and $\frac{1}{4}$-in. web, and stiffeners every 4 ft., as in Fig. 3. Rolled steel joist: By reference to Dorman Long & Co.'s section book, a 12 in. by 5 in. by 32 lb. rolled steel joist will carry 10 tons distributed over a span of 18 ft.; but 5 in. is narrow to build upon, and a $\frac{3}{8}$-in. top plate would be a desirable addition, as in Fig. 4.

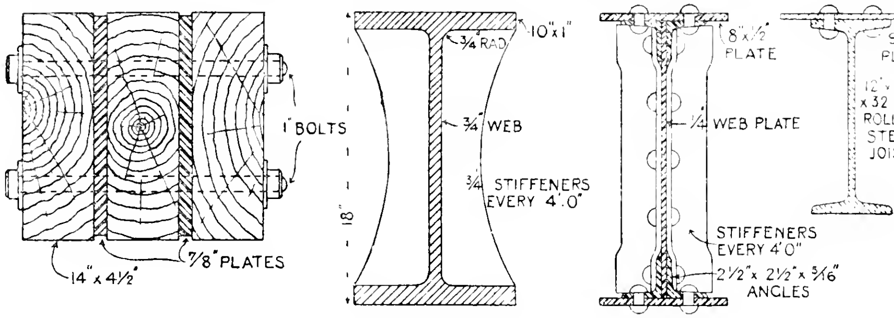


Fig. 1 *Fig. 2* *Fig. 3* *Fig. 4*

Comparative Designs of Girders.

Removing Crystoleum Picture from Broken Glass.—One means of removing an expensive crystoleum picture from cracked glass is to use hydrofluoric acid, but much depends on the process by which the picture was produced. Soak the broken glass and picture in water for some little time, then pour off and cover with a 5-per-cent. solution of hydrofluoric acid. After it has remained about a minute, stroke the extreme edges of the glass and gently coax the film to frill, when it may be rolled off the glass. Care must be taken to unroll the film in the same way, or the picture will be reversed. The film will probably expand readily, and if this is objected to, it should be brushed over with collodion before stripping. Contraction could also be obtained with methylated spirit, but would be difficult when dealing with so thin a film. Remove the broken glass and insert a sheet of waxed tracing paper underneath the film. Coat the new glass with thin gum (filtered), and lift the tracing paper by the two ends with the film lying on it, and lay down on the glass; it may then be worked into position, driving out air bubbles with a pad of wool.

Reducing Flint to Fine Powder.—Flint may be ground to a fine powder by first raising it to a red heat and quenching it in cold water, then grinding it either under edge runners or in a ball mill. The edge runners are two large granite rollers mounted on a horizontal shaft and revolving within a circular iron pan; for extremely fine grinding, water may be mixed with the flint. The ball mill is a cylindrical vessel built up of iron or steel plates, and having a number of rests or shelves of the same metal. Around the mill there are holes, below which are fitted fine sieves, and steel balls are placed inside the mill. Surrounding the mill is a sheet-iron cover, terminating below in a hopper. As the mill revolves the steel balls are carried up on the shelves and plunged down on the material below, while the pulverised material goes through the sieves into the outer casing of the mill, and is withdrawn from the hopper.

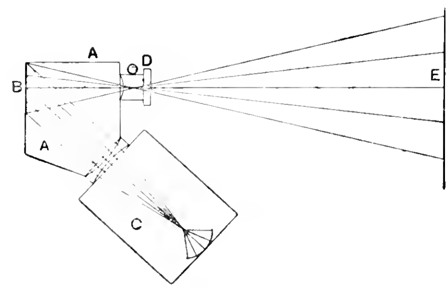
Making Harness Composition.—A good harness composition may be made by mixing 1 lb. of beeswax, 6 oz. of soft soap, $\frac{1}{4}$ lb. of ivory black, and 1 oz. of Prussian blue, with 2 oz. of linseed oil and $\frac{1}{2}$ pt. of oil of turpentine; heat on the hob or in the oven till melted and thoroughly incorporated, taking care that the vapours do not catch fire. Or melt together 2 oz. of mutton suet and 6 oz. of pure beeswax, then add 6 oz. of fine powdered sugar candy, 2 oz. of soft soap, 2 oz. of lampblack, and $\frac{1}{4}$ oz. of indigo in fine powder. When thoroughly incorporated, further add $\frac{1}{4}$ pt. of oil of turpentine. Keep in pots or tins. Lay a thin quantity of either on the leather, and polish gently with a brush or cloth rubber.

Distillation of Resin.—Resin is distilled by heating it in large iron retorts, when gases, water, acetic acid, resin spirit, resin oil, and resin pitch are left as a residue in the stills. The crude resin oil imported is too impure to be used except for the preparation of common lubricating greases. To purify the oil, it is first treated with sulphuric acid, washed with water, treated with soda, and again washed with water. It is then heated in a still and may be separated into portions of different gravity by collecting the portions distilling at different times in separate receivers. To do this, a hydrometer should be floated in the oil in the receiver, and the receiver changed as soon as the oil in it has risen to the gravity required. The next portion passing over will be collected separately and will have a higher gravity than the first one.

Particulars of Bates' Saccharometer.—Bates' saccharometer is used for determining the gravity of a wort or the percentage of sugar in a solution, in a similar manner to the Sikes' hydrometer. A weight must be placed on the stem of the hydrometer to sink the instrument so that it floats with only a portion of the scale below the surface of the liquid. The reading on the stem is added to that on the weight, and reference must be made to the book of tables supplied with the instrument to determine the gravity or percentage of saccharine matter.

Height and Width of Internal Doors.—The rule given by Vitruvius for determining the height of internal doors, and the ordinary rule when the width of the door is known, are the following. For Doric temples, the aperture of the door is determined thus: The height from the pavement to the lacunaria is to be divided into three parts and a half, of which two constitute the height of the door. The height thus obtained is to be divided into twelve parts, of which five and a half are given to the width of the bottom part of the door. This is diminished towards the top, equal to one-third of the dressing, if the height be not more than 16 ft. From 16 ft. to 25 ft. the upper part of the opening is contracted one-fourth part of the dressing. From 25 ft. to 30 ft. the upper part is contracted one-eighth of the dressing. Those that are higher should have their sides vertical. . . . If the doors are Ionic, their height is to be regulated as in those that are Doric. Their width is found by dividing the height into two parts and a half, and taking one and a half for the width below. The diminution is to be as in the Doric doorway. . . . If the doors are folding, the height remains the same, but the width is to be increased. If in four folds the height is to be increased." Adams: Quarter height of room + $4\frac{1}{4}$ ft. = height of door; height of door + 4 ft. = width of door. When width of door is given the ordinary rule is to add 4 ft. for the height.

Portrait Enlargements in Oil.—Painters of cheap oil portraits generally trace the outline with a pantograph or other similar appliance. Better class artists make a bromide enlargement on thin paper, rub the back with chalk, and trace through with a stylus. Such methods only give rough outlines. Of course, it would be possible to cast a shadow by means of the optical lantern by showing the object by reflected



How to Obtain a Reflected Image.

light, but it would be much less trouble to have a quarter-plate negative made. Fix this negative in one end of a box and adjust a lens at the other end at a suitable distance. Block up with brown paper a well-lighted window and place the box, negative side outwards, in an opening cut in the paper. If the canvas is supported on an easel at a proper distance opposite the negative it will receive the enlarged shadow. To obtain a reflected image, make a box A (see diagram) and attach the photograph at B. The lantern with the lens removed is placed at C. The rays are collected by the lens D and projected on to the canvas E. As only a small proportion of the light will be reflected, a powerful light will be needed. Two lanterns would be far better. It *might* be possible to use two incandescent or duplex paraffin lamps for a slight enlargement. Any lens of short focus and large diameter could be used.

Making an American Breast Collar for a Horse.—In making an American breast collar for a horse, assuming that the trace buckles are $1\frac{1}{2}$ in. wide, the body of the collar cut straight should be $2\frac{1}{4}$ in. wide and 3 ft. long, the lay $1\frac{1}{2}$ in. wide to fit the buckles, with the ends turned in for chapes so that the front of the buckles will be level with the end of the body. Put a lining in the chapes and two good loops, or one long loop, behind the buckle; the lay can then be cut of a wavy pattern from loop to loop in the centre, or it can be left straight. Then make four bearers the same as for breeching, but with four breeching dees instead of two dees and two rings; $\frac{3}{4}$-in. buckles will do for them; put one on each side between the buckle and loop, and the two others $4\frac{1}{2}$ in. from them towards the centre of the collar, and stitch the lay, loops, and bearers down. Now cut two or three thicknesses of thick fawn serging or a piece of thick felt and cover it with thin patent cowhide or basil, and see that it is the same size as the body both in length and width, joining the cover in the centre underneath and turning it in at the ends, then stitch to the body all along both sides; or stitch in with the lay and do away with this second stitching. Now cut the shoulder strap to hold it up 2 ft. 10 in. long and slit it 1 ft. at each end; finish up and punch the slits, and put two rings or large dees on each side of the centre close by the end of the slits for the reins to run through for driving purposes. If for cart work, it must be made stronger all through and coarser. The sizes given are for gig purposes; for a pony, the measures must be altered in proportion. If necessary, a small dee can be placed in the centre of the collar for putting a martingale billet in, the other end going to the bellyband between the horse's legs.

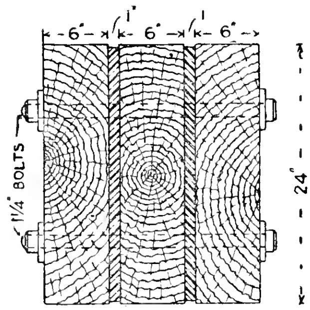
Strength of Flitched Beam.—Supposing a warehouse floor is to be supported by flitch beams, 10 ft. centre to centre, the span of the beam being 20 ft. and the load to be supported being 3 cwt. per superficial foot, the size of the beams and the thickness of the flitch may be arrived at as follows. Formula for flitched beam $W = \frac{d^2}{L}(Cb + 30t)$. Where W = breaking weight in cwt. in centre; b = total breadth of timber in inches; d = depth of timber in inches; t = thickness of flitch plate in inches; L = length of span in feet; C = 3 for Baltic fir. From the question, $20 \times 10 \times 3 = 600$ cwt. to be carried by each beam. Factor of safety, say, 6. Assume $b = 12$ and $t = \cdot75$,

$$\text{then } 600 \times 6 = \frac{d^2}{20}(3 \times 12 + 30 \times \cdot 75);$$

$$3600 = \frac{d^2}{20}(36 + 22\cdot 5);$$

$$d^2 = \frac{3600 \times 20}{58\cdot 5} = 1230.$$

This is evidently very wide of the mark, and an ordinary flitch beam will not meet the case. Assume oak timber



Strength of Flitched Beam.

(C = 3·7) in three flitches, each 6 in. thick, and two flitch plates, each 1 in. thick, then

$$3600 = \frac{d^2}{20}(3\cdot 7 \times 18 + 30 \times 1 \times 2);$$

$$3600 = d^2\,\frac{126\cdot 6}{20};$$

$$d^2 = \frac{3600 \times 20}{126\cdot 6} = 568;$$

$$\text{whence } d = \sqrt{616} = 23\cdot 83;$$

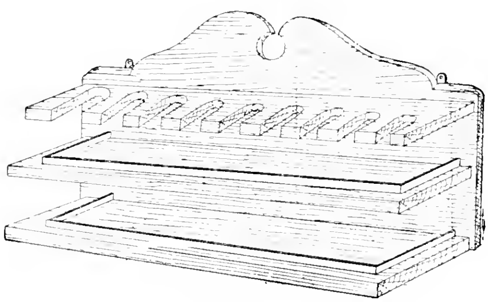
so that 24 in. deep would do, and the whole section would be as in the accompanying figure. If the question was correctly copied from the examination paper, it is clear that the examiner was wanting in a practical grasp of the conditions, as flitched beams are never used of such a size.

Painting Venetian Blinds.—Venetian blinds, if new, may be painted in the following manner. Remove all dust from the laths with a brush, and give the knots two thin coats of patent knotting. Beat up stiff in a pot 2 lb. of genuine white-lead ground in oil with 4 oz. of patent driers, using linseed oil and turpentine in equal proportion as thinners. Thin one-fourth of this with linseed oil for the priming coat. Add to the remaining three-fourths the pigments for staining the colour with which it is intended to finish. Take about two-thirds and thin with one-third linseed oil and two-thirds turpentine for the second and third coats; the remaining colour should be thinned with good carriage varnish for the final coat. Any colour pigments required should be bought ground in oil, and not in the form of powder. Strain the paints through fine muslin before using; allow plenty of time to dry between the successive coats, and rub down lightly with fine glasspaper. A much quicker method is to use colour mixed with spirit varnish, but the work done in this way does not stand so well as by the method described above. Do the painting in a warm room.

Dyeing Ostrich Feathers. To dye feathers black, soak them in nitrate of iron liquor at 70° B. for twelve hours, moving them well about; remove and wash, then boil in a decoction of 2 lb. of logwood and 1 lb. of quercitron or sumach in 1 gal. of water; remove, wash, dip in an emulsion made by shaking a solution of pearlash in water (1 oz. to a pint) with an equal measure of olive oil, and then swing the feathers about in a warm room, or pin them to a line to dry.

Walnut Stain for Light Wood.—A good walnut stain may be made by mixing vandyke brown into a thin paste with liquid ammonia, and thinning out with water till the desired tone is gained by at least two applications. The colour is enriched by a trace of red or black as may be desired in the polish.

Making a Smoker's Companion.—If it is to be painted and enamelled, white pine is about the best wood and easiest to work; but if it is to be polished, good hard kauri pine or American basswood will suit. If care is taken to select good stuff, either of these woods is easy to work, and will finish with a very good surface. The wood should be ½ in. thick. For the back, a piece 17 in. long by 11 in. wide will be required. It should be shaped at the top something like the illustration: a hole is bored with a 1-in. centre-bit, cutting from either side into it with a fret- or bow-saw, and finishing off with spokeshave, rasp, and glasspaper. The rack at the top should be 16½ in. long by 2¼ in. wide, and have nine openings for pipes. To make these openings, bore nine holes with their centres 1¼ in. from the front edge. The first three should be bored with a 1-in. centre-bit, the next three with a ⅞-in., and the last three with a ¾-in. centre-bit. Now cut into these from the front edge at a slight angle with a fine saw, thus making openings of the shape shown in the illustration. The edges should be rounded with a wood file and glasspaper. The middle shelf is 16½ in. long by 4 in. wide, and the bottom shelf 16½ in. long by 5½ in. wide. Both these shelves have a ledge round the fronts and ends, fixed ¼ in. from the edge. The ledge should be made by striking a $\frac{3}{16}$-in. bead on a piece of the stuff that is left, and carefully cutting it off. The large shelf should be fixed at the bottom of the back, the middle shelf 4½ in. above this, and the rack 2¼ in. above the middle shelf. The shelves should be screwed from the back with long fine screws such as 1¼ in. No. 5. Two small ears should be screwed on the back for fixing to the wall.



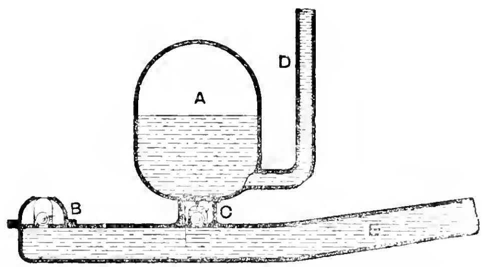
A Smoker's Companion.

Cementing Catches, etc., on Brooches.—Shellac is used for fixing the fastenings on brooches made of jet, shell, pearl, wood, or stone. A moderate heat only is required to unite them. In some cases "Coaguline," a cement obtainable of chemists, is used. Silver brooches can be repaired with ordinary tinman's solder. For a gold or gilt brooch, as well as silver ones, "hard" solder, purchasable under the name of "silver solder" or "gold solder," is preferable. These solders run at a red heat. The heat required to run tinman's solder does not injure gold or silver plating.

Hardening Axle Arms and Boxes.—To harden the iron arms of cart axles, place them in an iron box about three times the size of the proper box, sealing up the front end quite close; pack up the space between the axle and box with crushed bones and shreds of leather, close up the back end with clay or other substance so that it is air-tight, and place in a furnace with a good heat for about eight hours, when the bone and leather should be consumed. Allow to cool, fill up the space with powdered potash, replace in the furnace again until it is consumed, then take it out, and allow to cool until black hot, when it should be cooled out in a tub of strong salt and water. To harden the insides of boxes, make them fairly hot, charge the insides with potash, and revolve them until the potash is consumed; repeat this, then cool out as before. In Moxon's "Mechanical Exercises" the method of case-hardening is thus described: Take cow-horn or hoof, dry it thoroughly in an oven, then beat it to powder; put to it an equal quantity of bay salt, and mingle them with white wine vinegar. Lay some of this mixture upon loam, and cover the iron all over with it; then wrap the loam all about it, and lay it on the hearth of the forge to dry and harden. Put it into the fire when dry; when it attains a blood-red heat, withdraw, and allow to cool out.

Removing Paint or Varnish from Furniture.—The following is a method of removing paint and varnish from furniture without using glasspaper or a burning lamp. To each bucketful of freshly slaked limewash add 2 lb. or 3 lb. of common washing soda and a pennyworth of rock ammonia. Apply liberally by means of fibre brushes. For carved portions, make the solution thicker by adding more lime or sawdust. Scrape off the varnish as it softens; several applications may be given. Swill off with plenty of clean water, and brush over with common vinegar before applying any stain. For delicate and turned work, a solution of hot borax water and rock ammonia will generally suffice. Or make a pickle as follows—½ lb. of American potash, ½ lb. of soft soap, ½ lb. of rock ammonia, 1 lb. of washing soda, and 1 gal. of water.

Particulars of Hydraulic Ram.—The adjoining illustration gives a diagrammatic section of a hydraulic ram. A is an air vessel, B and C ball valves, D a delivery pipe, and E the supply pipe. Above the valve B is an opening, and the water, in running down from a small fall at E, passes through this outlet until the velocity is sufficient to close B. This, of course, suddenly stops the stream, and the outlet valve C is forced open owing to the great increase of pressure in the ram. Through C the water passes into A and up the delivery pipe D. This releases the pressure and the valves B and C fall and the operation is gone through again. In some cases an ordinary lift or a flap valve, which must be weighted to exceed slightly the static pressure of the supply stream, is placed between E and C. Obviously, a portion only of the supply water from a small fall is delivered to a greater height, and the average efficiency of the ram is probably not more than 50 per cent.



Section of Hydraulic Ram.

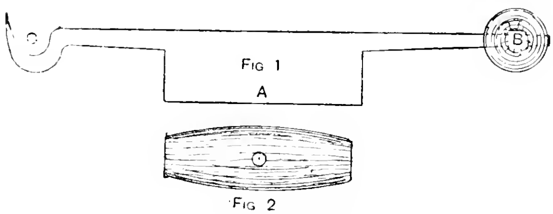
Removing Varnish from Old Oil Painting.—In removing cracked varnish from an old oil painting, gently rub the surface of the painting with the dry fingers. By continual rubbing the varnish will come off in the form of fine dust. Experts sometimes spend days or weeks over a single canvas. Spirit of wine or turpentine may be used to dissolve hard old varnish, but both will attack the paint as well as the varnish if the action is not stopped in time by applying water freely. A weak solution of ammonia or reduced alcohol is also used to soften the surface, which is then slowly scraped away.

Strengths of Metals.—From the following list, which gives the average breaking stresses in tons per square inch, the relative strengths of cast iron, cast steel, gun-metal, and brass may be obtained. In tension: Cast crucible steel, 45 tons; mild steel, 35 tons; steel for castings, 30 tons; gun-metal, 12 tons; brass, 11 tons; and cast iron, 7½ tons. In compression: Cast crucible steel, 80 tons; cast-iron, 45 tons; gun-metal, about 12 tons; and brass, about 11 tons. In shear: Cast crucible steel, about 30 tons; steel for castings, about 20 tons; gun-metal, about 8 tons; and cast iron, about 5 tons. The safe stresses for live loads are as follows. In tension: Cast crucible steel, 8 tons; steel for castings, 5 tons; gun-metal, 2 tons; brass, 1½ tons; and cast-iron, 1¼ tons. In compression: Cast crucible steel, 8 tons; steel for castings, 5 tons; gun-metal, 2 tons; brass, 1½ tons; and cast iron, 4 tons. In shear: Cast crucible steel, 5 tons; steel for castings, 3½ tons; gun-metal, 1½ tons; brass, 1 ton; and cast iron, 1 ton.

Methods of Cleaning Garments.—It must be first ascertained whether the garment to be cleaned is liable to shrink, and also whether its colour is fast. Small paint or grease spots may be removed by rubbing with a rag on which a little benzine has been poured. Grease marks may often be removed by putting a piece of blotting-paper under a warm iron and pressing. Trousers of a light woollen nature, if soiled to any extent, are best washed in warm water, and dried in the open air. They should not be scrubbed or wrung out. Garments of a dark colour and all black cloths should be cleaned with a solution of liquid ammonia, about two teaspoonfuls of the latter to a pint of tepid water; if the water is too hot, the ammonia will evaporate quickly, and the cleaning power of the solution thus decrease. A brush should be used and the garment rubbed from top to bottom, not crosswise but with the warp of the material. After the garment is cleaned it should be ironed and pressed.

Rules for Window Area for Room.—The rules for window area are as follows. Sir W. Chambers: $\frac{\text{depth of room + height}}{8}$ = width of window; height = 2 to 2½ times width. Gwilt: 1 ft. super. of light in a vertical wall to every 100 cub. ft. in room. R. Morris: square root contents of room = super. area of window; sill 2 ft. 6 in. to 3 ft. from floor; head as high as possible. J. S. Adams: square root (height window^2 ÷ 2) = width, or width = side of square whose diagonal is the height. Sir Douglas Galton: 1 ft. super. window space to every 100 cub ft. or 125 cub. ft. contents of room in dwelling-houses; 1 ft. super. to 50 cub. ft. or 55 cub. ft. in hospitals.

Umbrella-maker's Stock Knife.—Fig. 1 shows a side view of an umbrella-maker's stock knife, A being the cutting edge of the blade, and B the handle. An ordinary eye-bolt is put through the bench in a convenient position and secured by a nut underneath. The hook C (Fig. 1) fits into the eye of the bolt. A piece of hard wood should be fitted to take the cutting edge of the knife. Fig. 2 shows the shape of the knife handle. This tool is used for cutting the ends of sticks to fit the ferrules, which should always be shouldered on.

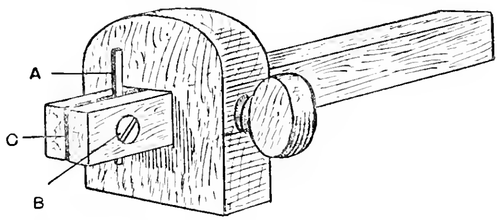


Umbrella-maker's Stock Knife.

Black Fillings for Headstones.—The following is a recipe for a bright non-staining black for monumental work. Dissolve in a bottle by the aid of heat black sealing wax in methylated spirit, and keep the bottle near a fire for one day, shaking it at intervals of about one hour. This mixture will not crack when it gets hard. Thin it with methylated spirit and apply with a brush. To fill lettering on monumental work, use equal parts asphaltum and guttapercha, dissolved in a tin can. Hot asphaltum used alone is too brittle, but the two together make a first-rate filler. To fill lettering to resemble lead, make up some Parian cement with water, stain it with lampblack and a dash of blue, fill in the letters when dry, and clean off the surface.

Recipes for Aluminium Solders.—The difficulty in getting solder to adhere to aluminium is caused by a metallic film (probably an oxide) which forms on the surface of the metal while heated, and which prevents ordinary soft solders alloying to form a strong joint. A flux might be used to render the surface of the aluminium pure during the soldering operation, or the film might be removed by mechanical means, or a solder devised that would dissolve, or combine with the film on the surface of the metal while both solder and aluminium were heated. The composition of a really reliable flux for soft soldering has not been made public, consequently either of the two latter methods must be adopted. For working with a tinned copper bit the solder should melt at a moderate temperature, and should contain only small proportions of brittle metals, solders containing much brittle metal usually showing decreased malleability and ductility. Alloys of an easily fusible nature are recommended for soldering aluminium by the following authorities. Frishmuth, of Philadelphia, says: tin 95 parts, and bismuth 5 parts; or tin 97 parts, and bismuth 3 parts; while J. Richards recommends aluminium 2·5 parts, zinc 25·25 parts, phosphorus ·25 parts, and tin 72 parts. Other alloys for this purpose are aluminium 1 part, tin 9 parts; or cadmium 5 parts, zinc 2 parts, and tin 3 parts. Also phosphor tin (in variable proportion); or tin 20 parts, and zinc 1 part; or tin 99 parts, and copper 1 part; or tin 90 parts, copper 9 parts, and bismuth 1 part. Any of these can readily be fused with a copper bit, which, to ensure success, should be of a wedge shape bent round to, roughly, a quarter circle. Its edge is then at right angles to the aluminium, and, by lightly moving the bit backwards and forwards while in contact with the aluminium and flowing solder, the impure film is removed. The coated surface can then be soldered with an ordinary shaped copper bit. Phosphor tin probably owes its adhesiveness to the affinity of phosphorus for oxygen, a molten alloy containing phosphorus placed on aluminium tending to absorb oxygen from the impure film as well as from the surrounding air. When soldering, everything should be perfectly clean, the soldering being performed quickly, as if the surface is not coated at the first attempt the aluminium surface is injuriously affected, and good soldering becomes almost impossible unless the affected surface is removed by scraping or filing.

Inlaying Stringing in Cabinet Work.—When inlaying stringing round drawer fronts or on taper table legs the mode of procedure is as follows. From a bit of broken bow-saw, or a bradawl filed to width, make a steel cutter to the width of the stringing. The cutter A in the illustration is secured by a screw B in a saw kerf C, an ordinary gauge being used to hold the cutter, which protrudes as much as the thickness of the stringing. Satinwood or boxwood stringing can generally be obtained from cabinet makers. Set the gauge to the required margin round the drawer fronts, or from the edge of the legs, and scratch the channels for stringing. The gauge is held as in ordinary gauging. To make a clean job, where the channels for stringing cross the grain of the wood, cut two lines with a knife, and then rout out the wood with a small chisel or with the cutter. The various lengths of stringing may then be fitted into their channels. Where the stringing intersects at the corners it must be mitred. Next take each length and put on the glue by running it against the glue brush over the glue pot. Press the stringing into the channel by the aid of the face or the back of the hammer. When the work has had time to dry, say in about twenty-four hours, the job may be cleaned up and glasspapered.



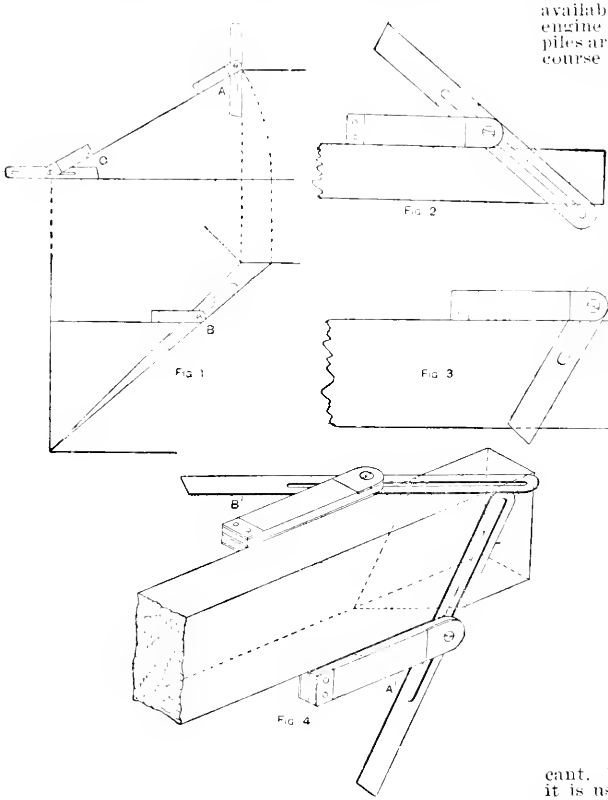
Gauge for Inlaying Stringing in Cabinet Work.

Dyeing Leather for Gloves.—Leather is sometimes dyed in the vat and sometimes by simply brushing over with the dye liquid. For instance, a leather may first be tanned and then transferred to a vat containing pine and elder barks to give it a tan or russet brown colour. Browns and yellows are obtained by damping the leather and brushing over it a decoction of saffron, annatto, a mixture of brazil wood and yellow berries, etc., also by using a solution of an aniline dye, as picric acid, phosphine, Bismarck brown, or acid brown. Other suitable dyes are magenta, methyl violet, Russian green, brilliant green, methylene blue, crysoidine, nigrosine, etc. Blacks are usually obtained by brushing over with a decoction of galls and, after drying, a solution of copperas or pyrolignite of iron. After dyeing the leather and drying, it should be rubbed up with a waxed cloth to impart a dull polish. Many of the aniline dyes are best fixed by an after treatment with a decoction of nutgalls. Picric acid may also be used for fixing purposes, but it yields compound shades

Black Stain for Wood.—To obtain a dense black stain for wood, boil together in an old iron pot 1 gal. of strong vinegar, 2 lb. of extract of logwood, ½ lb. of green copperas, 2 oz. of China blue, and 2 oz. of crushed nutgalls; then add ½ pt. of acetate of iron, made by steeping rusty nails or iron turnings in common vinegar. Apply liberally with a brush. The wood must be perfectly free from grease and glue, and should be handled as little as possible.

Making Pressed or German Yeast.—Pressed or so-called German yeast is made in a similar way to ordinary brewer's yeast, but it is the yeast derived from the fermentation of a mash which is afterwards distilled for whiskey. The yeast is collected from the surface of the fermented liquid by a scraper, and is then put through a filter press which presses out the greater part of the water, leaving a stiff, pasty mass which is cut up into 7 lb., 14 lb., or 28 lb. lumps and sewn up in bags.

Taking off Bevels for Rafters.—An explanation of how bevels for rafters are taken off the drawing and put on the stuff to be cut is here given. Set out for the bevels as shown at Fig. 1; the bevel at A being for the vertical cut, and that at B for the bevel to be applied at the edge of the rafter. The bevels can be set from the drawing as shown at Fig. 1. Fig. 2 shows the bevel B (Fig. 1) applied to the top edge of the rafter, and Fig. 3 shows bevel A (Fig. 1) applied to the side of it. This will perhaps be more clearly understood from the isometric view given at Fig. 4, which shows the application of the bevels. The form of the cut C (Fig. 1) is the bevel for feet of rafters.

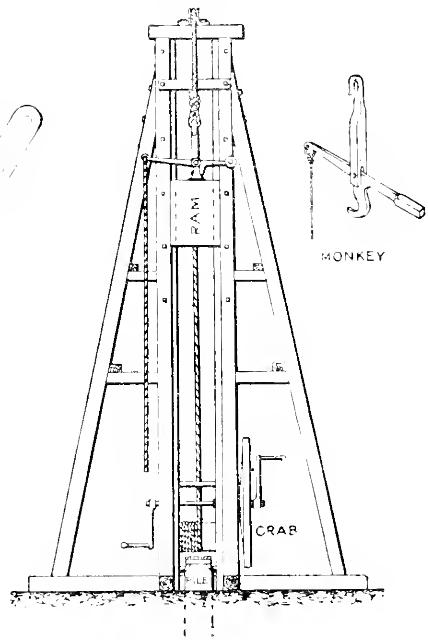


Taking off Bevels for Rafters.

Brass-plating Solutions.—The following are brassing solutions. Water, 160 parts; copper cyanide, 2 parts; zinc cyanide, 1 part; and potassium cyanide, 15 parts. Or water, 250 parts; copper sulphate, 1 part; zinc sulphate, 8 parts; and potassium cyanide, 18 parts. Watt's solution is made by dissolving as much sheet brass as possible in warm dilute nitric acid, the fumes given off being poisonous. Next add this solution to water in the proportions of 2 oz. of brass per gallon of water, and add strong liquid ammonia until a deep blue colour results. Add strong solution of potassium cyanide until a pale yellow colour is obtained. Filter this, and finally add water so that the proportion is 1 oz. of brass to 1 gal. of the solution. This solution, which can be used hot or cold, should be kept some hours before use.

Removing Ink Stains from various Articles.—Ink stains may be removed from a mahogany table by touching the part stained with a feather dipped in a mixture of a few drops of spirit of nitre and a teaspoonful of water. Immediately the ink stain disappears the place must be rubbed with a rag wet with cold water, otherwise a white mark will appear, which will not be easily removed. Strong muriatic acid, or spirit of salt, applied with a piece of rag, and afterwards well washed off with water, will remove stains from boards. To remove stains from silver or plated articles without injuring them, make a little chloride of lime into a paste with water and rub the stains until they disappear, and afterwards wash the articles with soap and water. Stains can be taken out of coloured tablecovers by dissolving a teaspoonful of oxalic acid in a teacupful of hot water, and rubbing the stained part well with the solution. To remove stains from white cloths, put a little powdered salt of lemon on the part affected, damp it, allow it to remain about five minutes, and wash it out with soap and water, when the stain will disappear.

Engine for Pile Driving.—The illustration shows the general arrangement of a small pile engine worked by hand power; larger ones are on the same principle. The boiler and winch will depend upon the money available, but a vertical boiler with small winch engine attached will probably be suitable. Oblique piles are driven by canting the pile-engine; the blow of course loses in efficiency according to the amount of cant. For moving the pile-engine about a job on shore, it is usual to lay down a pair of rails and to prise the engine along them. For transportation by water, a barge is the best means, but if by road a lorry, lurrie, or low trolley is usual, the engine being carried erect, if there are no bridges to pass under, and being made fast by guy ropes from the top to the angles of the lorry.

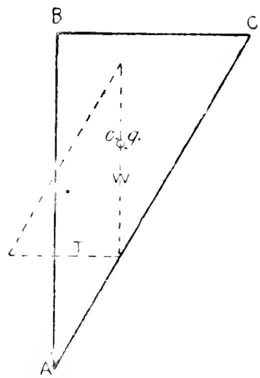


Engine for Pile Driving.

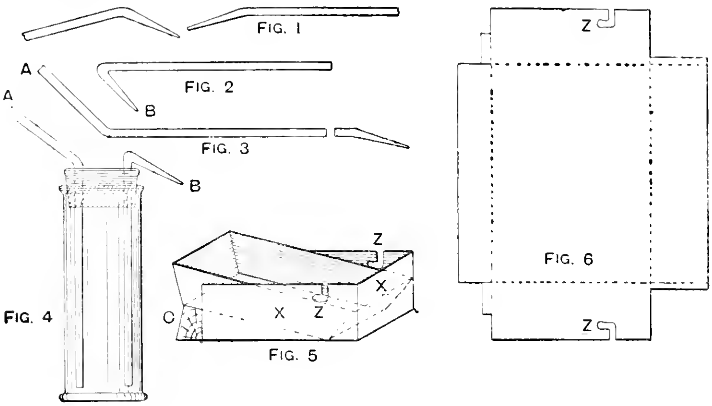
Working Leaves in Wrought Iron.—The process of cutting out and shaping leaves in wrought iron is briefly thus. The pattern of the leaf required is traced from the drawing gummed on to a suitable piece of sheet iron, which for hammered work may be of the best quality Lowmoor, though Swedish iron is preferable. The outline of the leaf is then carefully cut out with a steel chisel, after which the leaf is heated all over to a uniform temperature and hammered into the required shape on the beak iron of the anvil or the swage iron. As the parts of the leaf are shaped they may be cooled by dipping in water, or water may be poured on, leaving only the unshaped parts red hot. Hammers of various sizes and with different shaped ends will be required, and also flat-, square-, and round-nosed pincers. A very useful tool is a thick cast-metal block, on the surface of which have been sunk the shapes of the leaves that are required. Into these moulds the red-hot metal may be beaten and worked into shape, after which the leaves may be re-heated and bent with the pincers or hammered with round- or oval-faced hammers, so as to give a different effect to each leaf.

Composition for Casting Ornaments in Relief.—A composition in which to cast a panel (say) of birds, modelled in low relief, may consist of 7 lb. of glue, 3 lb. of resin, 1½ pt. of linseed oil, and about 2½ pt. of water. Steep the glue in water and melt in the usual way; then melt the oil and resin separately, and pour into the glue. Next add well-powdered whiting till the mass is of the consistency of thick dough. Well knead the mixture till the whole is smooth and plastic. Press the composition into the mould, which should first be well oiled. To extract the pressing from the mould, reverse the latter on a damp board, to which the composition will adhere, and so enable the mould to be pulled off. This composition sets extremely hard, and may be glued to any panel desired. Another suitable composition consists of fine glue 3 parts, isinglass 1 part, dissolved in water till the mixture, when cold, is like jelly. Gently heat this and mix with finely sifted sawdust till the whole is sufficiently thick to be workable. Press the composition into the mould, place a weighted board over it, and set before the fire to harden and dry.

Pressure on Retaining Wall.—The following is the method employed in computing the pressure exerted by earth on a retaining wall of any thickness, with the earth at a given angle of repose. The earth above the line of repose adheres to that below, and the angle of repose is only reached after a long period of exposure to the weather, so that there is no tendency for the whole mass to move at once. The bisection of the angle of repose with a vertical line gives the line of rupture, and the wedge of earth between the line of rupture and the back of the wall is considered to be the amount pressing on the wall, or where fracture would originate if the wall yielded. Let A B C be this wedge of earth, A B a vertical line at the back of the wall, A C the line of rupture, and *c g* the centre of gravity of the wedge. Draw a vertical line W through the centre of gravity touching the line of rupture and equal in length on any given scale to the weight of the wedge of earth. At its base draw the horizontal line marked T, which will be at one-third the height of the wall, and cut it off to the length shown by a line from the upper extremity of W parallel to the slope of the line of rupture. Then T will equal the thrust on the wall by the earth at the back.



Pressure on Retaining Wall.



Apparatus for Applying Bromide Solution to Paper.

Use for Broken Band-saws.—An advantageous method of disposing of broken band-saws is here suggested. Place the broken saws in a fire, and well heat them. When cold, the pieces will be very soft, and will be much better than hoop-iron for binding shafts in pairs, and pick and shovel handles, etc., into bundles.

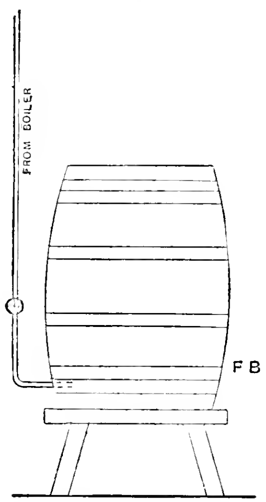
Enamelling and Embossing Photographs.—To produce the permanent enamel seen on photographs, thoroughly clean a sheet of plate-glass and dust over it a little French chalk, every trace of which should afterwards be removed by careful polishing. Next coat the glass with enamel collodion and allow it to set. The wet print is then laid face down on the collodion surface and well squeegeed to remove air bubbles, and afterwards set up in a warm room to dry. When nearly dry, a piece of waterproof backing paper is fastened over the back of the print, using stiff starch paste. When thoroughly dry, a knife slipped round the edge should be sufficient to cause the print to leave the glass readily. The collodion film is used for the purpose of supplying a glaze to matt or albumenised papers; but if P.O.P. (which is already glazed) is used, the collodion facing may be dispensed with, the wet print being merely squeegeed down on the chalked glass and treated as already described. Embossing is done by means of a press, obtainable of most photographic dealers. The raised portion is then filled in with wadding, the print being attached only at its edges.

Applying Bromide Solution to Paper.—The method of applying the bromide solution suggested by Captain Abney is an excellent one, and consists of spraying it with a sort of wash bottle made as follows. Fit a cork to a 1-in. bore test tube or a small wide-mouth bottle. Take a length of glass tubing, and separate it into two portions about 3 in. longer than the extreme depth of the bottle by gently heating in a spirit or gas flame, keeping it revolving all the time until the glass softens, when it may be pulled steadily apart as shown in Fig. 1. If the tube is wetted or breathed on, it may crack. Warm again in the same manner, and bend to the shape shown in Fig. 2. Cut away the closed portion from the other piece by scratching with a file and snapping off. Then bend as shown in Fig. 3, melt the end A to soften off the edges, and, whilst soft, squeeze flatter with the pliers, pressing very gently. Now bore two holes straight and parallel through the cork, a little smaller than the tubing; a rat-tail file can be used if a borer is not available. Insert the tubes in the cork, and the cork in the test tube. Strip off the extreme end or tip B, which will give a tiny hole. It will then present the appearance shown in Fig. 4. The part A should be put in the lips, and a gentle current of air forced through, when a fine spray will result. For coating the paper a trough will be necessary; or a dish may be used, set at an angle as shown in Fig. 5, and supported by a block C. On a glass rod or a length of glass tubing, roll some lengths of chemically pure paper to about ½ in. thick, and glue down. This will make a roller about 1¼ in. thick, the thick part to be shorter than the dish. Now wind upon it as tightly as possible, coated side outwards, some Rives or Saxe paper of suitable width, and fasten with a rubber band at the extreme edges. Construct a tank of metal (see X, Fig. 5), the pattern of which is shown in Fig. 6, and bend on the dotted lines and solder together. The two ends of the tubing are now placed through the cuts Z Z, bringing the paper well below the sides of the dish. Now fill the lower tank with boiling water, and pour the melted emulsion into the porcelain dish, which should be free from cracks. Unwind the paper slowly, passing it through the emulsion. Withdrawing the paper rapidly gives a thicker coating. The paper as coated should be drawn over laths placed above the tank, and allowed to dry spontaneously in a well-ventilated room free from dust.

Chimney-cleaning Materials.—The recipes for the compositions which, when placed on the fire, cause the soot to be removed from the chimney, are trade secrets. By one plan the fire is got into a bright condition, then a very thin layer of small coal is put on. On top of this is laid a whole stick of sulphur; this measures about 7 in. long by 1¼ in. diameter, and is perhaps better known as brimstone in the stick form. The stove is then closed up and the damper opened full. This method is of use with closed stoves only; it also answers to extinguish a chimney fire. With open grates some form of blower must be employed to make the draught sufficiently strong, but this is a necessary condition also with the packets of materials before referred to. The efficacy of the sulphur is said to be improved by placing with it one or two raw onions on the fire.

Removing Silver Stains from a Negative. Rusty brown stains on photographic negatives are caused by damp, and are known as silver stains. If the stains are old, it is, as a rule, impossible to remove them, but either of the following methods of treatment will make them fainter. Soak the negative and immerse for a short time in sulphocyanide of ammonium 1 dr., water 1 oz., and transfer to nitric acid 1 dr., water 1 oz., without any washing. Or try the following. Thiocarbamid 6 gr., citric acid 10 gr., chrome alum 20 gr., water 2 oz. Allow the negative to soak in this solution, and the stains will probably be reduced. In either case, the removal of the stains will be greatly assisted by a little gentle friction with a tuft of wool.

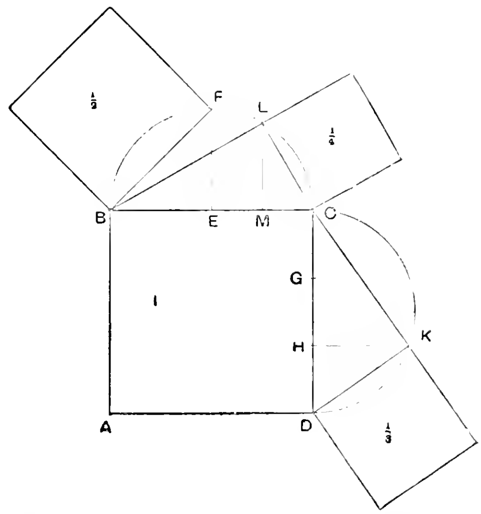
Artificially Seasoning Small Lumber.—A very effective and simple apparatus for artificially seasoning small and short lumber can be put up wherever a small quantity of steam from the boiler or exhaust of a steam engine, say—is available for use. The material to be treated is placed, preferably on end, in a large steam-box or barrel, and allowed to become thoroughly saturated with the steam. This will take from two to ten hours, according to the kind and thickness of the wood. No pressure is required, but the top of the barrel should be closed with a lid. The apparatus should not be kept inside a building on account of the escaping steam. A false bottom of wire netting or something similar is placed across the barrel at F B (see sketch) to keep the material being treated away from the bottom proper and allow the steam to become evenly distributed. After it is taken out the wood is piled under cover in the ordinary manner and allowed to dry; this, in small thin material, usually takes three weeks or a month. The drying time might be considerably shortened by utilising the space above the boiler as a drying loft. A temperature of 120° to 180° F. (obtainable above most boilers) would get the drying over in a day or two, but the material should not be transferred to such a position direct from the steambox: let it have a few days' ordinary drying first. The apparatus is quite suitable for steam-bending purposes, but for treating rims and sticks for lawn-tennis and lacrosse rackets a long horizontal box, as used by boatbuilders, should be made, having as small a capacity as possible consistent with the work it will be required to do. The steam pipe should be introduced at about the middle of its length, and the material inserted from the end. If no boiler from which steam could be drawn is accessible, the cheaper plan would be to forward a parcel to a drying-kiln proprietor and have the drying done by contract.



Apparatus for Artificially Seasoning Small Lumber.

Pneumatic Key Actions for Pipe Organs.—In small organs the closer the connection between the player's fingers and the pipe valves the better, because the staccato and legato touch can be more easily made to respond exactly to the player's fingers; he can if he wishes open and close the valves gradually, but with pneumatic actions the pallet is always made to open and close as rapidly as possible. A pneumatic action opens a small bellows instead of the pallet leading to the pipes. The movable part of the bellows is made to work the action, which remains nearly the same as before. A tubular pneumatic action has a bellows at each end of a connecting tube; compressing one bellows distends the other, which becomes the motive power to open the pipe pallets. Trackers, squares, rollers, etc., are thus rendered unnecessary. In electric action an electromagnet is generally used to open the valve nearest the finger or to compress the bellows in the tubular pneumatic action. In this case the key has only to make contact and break it. One way in which this is done is by a U-shaped wire staple in the underside of the key, which, when depressed, enters two small cells of mercury into which the ends of the connecting wires are led. This action is not generally used apart from the pneumatic action, because if independent the electromagnets would require to be inside the wind-chest, and this would be inconvenient when adjustment became necessary.

Determining the Sizes of Gauge Boxes for Compo.—The following instructions are for determining the areas of square gauge boxes of four different sizes, No. 1, to measure 1 yd. of sand, being given as 3 ft. square and 3 ft. deep; No. 2, to measure ½ yd. of sand or cement; No. 3, to measure ⅓ yd. of cement; and No. 4, to measure ¼ yd. of cement. It is supposed that all the boxes are to be of the same depth, and so it is only necessary to find the lengths of the respective sides. To do this, find the area in each case, and the square root will give the length required. The area of the first box being 9 ft., the area of the ½-yd. box will be 4·5 ft., the area of the ⅓-yd. box will be 3 ft., and the area of the ¼-yd. box will be 2¼ ft.; therefore, extracting the square root in each case gives $\sqrt{4{\cdot}5} = 2{\cdot}14$ or practically 2 ft. 1¾ in.; $\sqrt{3} = 1{\cdot}7$ or practically 1 ft. 8⅜ in.; $\sqrt{2{\cdot}25} = 1{\cdot}5$, or practically 1 ft. 6 in., which gives the length of the sides in each case. To determine this by geometry, let A B C D represent the area of the larger box, drawn to scale. Now, on the side B C construct a semicircle, and bisect B C in E, and draw E F perpendicular to B C; then joining B F gives the side of a square half the area of the square A B C D. Next divide C D into three equal parts, as shown, and on it construct a semicircle and draw H K perpendicular to C D; then joining D K and C K gives sides of squares one-third the area and two-thirds the area of the larger square. The construction of the quarter area of A B C D is similarly shown at C L.

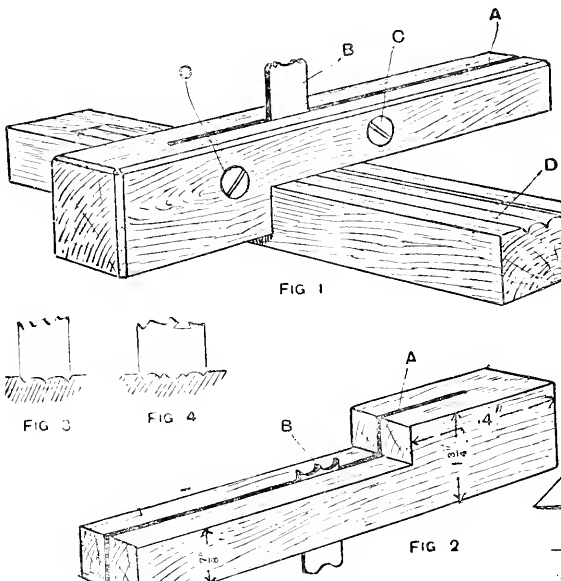


Determining the Sizes of Gauge Boxes for Compo.

Diameter of Rivets for Boilers.—A list of diameters of rivets to be used with boiler plates of given thickness is here presented. The diameter of the rivet may equal 1·2 times the square root of the thickness of the riveted plate. On this basis the following is a list such as is required—$\frac{5}{16}$-in. plate, $\frac{11}{16}$ in. diameter; ⅜-in. plate, ¾ in. diameter; $\frac{7}{16}$-in. plate, $\frac{13}{16}$ in. diameter; ½-in. plate, ⅞ in. diameter; ⅝-in. plate, $\frac{15}{16}$ in. diameter; ¾-in. plate, $1\frac{1}{16}$ in. diameter; ⅞-in. plate, 1⅛ in. diameter; and 1-in. plate, 1¼ in. diameter. The following has been given as the practice of Lancashire boilermakers. For ⅜-in. and $\frac{7}{16}$-in. plates, ¾ in. diameter; for ½-in. and $\frac{9}{16}$-in. plates, $\frac{13}{16}$ in. diameter; for $\frac{11}{16}$-in. and ⅝-in. plates, ⅞ in. diameter; and for ¾-in. and 1-in. plates, $\frac{15}{16}$ in. diameter.

Relaxing Bird Skins.—For relaxing bird skins, line the inside of a wooden box with a 1 in. layer of plaster-of-Paris, well mixed. When dry, the box is ready for use. Pour water inside sufficient to saturate the plaster, and, after turning out the surplus water, place the skins inside. Cover them with a damp cloth and close the lid, which should fit well. Now place the box in a damp shady place (such as a cellar) until the skins are relaxed; this will be known by the feet, wings, and tail being soft enough to spread out with gentle handling. Another method is to half fill a box with silver sand and well damp it. Wrap each skin in a piece of rag and cover the whole with more damped sand. The rag will keep the feathers from actual contact with the sand, but will allow the moisture to penetrate. The average time for small birds up to the size of a thrush will be about twenty-four hours; for grouse size, about two days; for heron size, three days; for eagle size, four days. When the legs will bend a little, work them about till they bend easily.

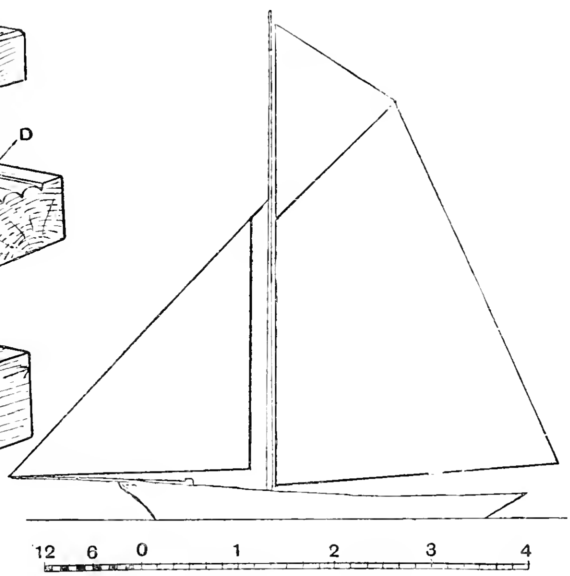
Scratch Plane for Working Beads and Mouldings.—Fig. 1 is a perspective view of a scratch plane for working beads and small mouldings, and Fig. 2 is a view of it upside down. For the stock, a piece of birch or beech about 10 in. long is used, and a saw kerf A (Figs. 1 and 2) is cut nearly the whole length; the cutter B, of sheet or broken saw steel, is placed in this slot and kept secure by the screws C. Fig. 3 shows the cutter shaped for making a couple of beads D (Fig. 1). The cutter may be made to the desired shape with a file, the edge of the cutter being kept flat like a scraper. It is then finished with an oilstone slip of the reverse shape—that is, round. In working, the scratch is moved forward or backward, and is held by the right hand at the right end, and by the left hand at the left end of the job, the stock being kept well against the work. Having scratched the mouldings, next clean them up with sandpaper, wrapped about a piece of pine, say 3 in. long, 2 in. wide, and ¼ in. thick, the edge being the reverse shape to the bead or hollow. Fig. 4 shows a cutter for another pattern of beads.



Scratch Plane for Working Mouldings, etc.

How to Make a Platinum Toning Bath.—When using a chloro-platinite of potassium toning bath with Ilford P.O.P., print scarcely so far as for treatment with ordinary gold and sulphocyanide bath. Dissolve 15 gr. of potassium chloro-platinite in 15 dr. of distilled water; label this "Stock platinum solution, 1 grain in 1 dram." As it is liable to change—the platinum being precipitated—if exposed to light, it should be kept in a dull light or, preferably, in the dark room. For toning one sheet of paper, make up the following: Dissolve 50 gr. of chloride of sodium (common salt) in 10 oz. of distilled water and add 100 gr. of alum, and finally 2 dr. (2 gr.) of stock platinum solution. The bath is ready for immediate use, but does not keep satisfactorily more than a day or so. Should any sediment be thrown down, indicating the presence of impurities, the bath should be discarded. Thoroughly wash the prints, which must not be in an acid condition. It is advisable to pass them through a 5-per-cent. solution of carbonate of soda (1 oz. of washing soda in 20 oz. of water), and again wash before toning. It is difficult to tell when the prints are correctly toned until experience is gained, but they should not be toned longer than five minutes in winter and rather less in summer. When toned, place in a 2½-per-cent. solution of common salt, which stops the toning. Thoroughly wash and fix for twenty minutes in hypo 2 oz., water 1 pt., or a 10-per-cent. solution. Finally wash for two hours. In all the operations the prints should be kept well separated, hence it is advisable to tone only a few at a time and to use two dishes of hypo and transfer from one to the other. The same plan should be adopted in washing, if unprovided with a washing tank. The above is specially recommended by the Britannia Co. for their Ilford printing paper.

Sail Plan for Model Yacht.—Accompanying this sail plan is a scale in feet and inches for a 10-ton model yacht 59 in. long over all, water-line 40 in., beam 7½ in., depth 12 in., with a 25-lb. lead keel, and from the plan all measurements required can be taken. The foresail should have a light boom laced to its foot. Rig lightly, and with no unnecessary gear.



Sail Plan for Model Yacht.

Removing Dents from Brass Musical Instruments.—To remove dents, with a blowpipe or soldering bit carefully solder in the hollow a suitable brass plug. When cold, take hold of the plug and pull the dent carefully out. Then unsolder the plug, and wipe off the melted solder with cotton waste or rag. With very fine emery cloth remove every trace of solder. To remove dirt, etc., use turpentine applied with a rag; afterwards, rottenstone and oil, or tripoli and oil. Finish off with list and dry powdered lime.

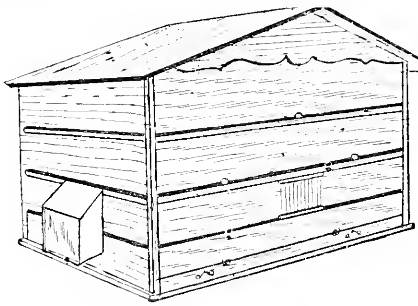
Asphalt for Damp-proof Course.—Asphalt for a damp-proof course may be prepared by boiling, for a few minutes only, coal-tar (about 21 gal.) and pitch (1 cwt.) in an iron boiler, thinning with 2 gal. of creosote oil. Brush the footings clean, sprinkle a little sand on, and with a trowel make a little ridge of mortar along each edge of the brickwork to prevent the melted tar and pitch running off. Then pour on while hot from a ladle or a bucket.

Particulars of Vulcanite.—Vulcanite is made by heating indiarubber with about half its weight of sulphur, and is coloured by incorporating with it mineral pigments—lampblack for black, antimony sulphide or vermilion for red, zinc white for white, etc. In making plates on which artificial teeth are fixed, the vulcanite, while hot, is pressed to shape in moulds, the teeth being previously fixed in the moulds in the positions they are to occupy.

Converting Boat's Sail into Waterproof Cover for Boat.—Presuming that a canvas sail is to be turned into a boat cover, a wooden ridge should be fitted to support the cover, fore and aft resting on the breast hook forward, and the stern aft. The cover must then be made, if possible, in such a way that the seams will be athwartships, *i.e.* at right angles with the ridge over which it will be stretched, and secured by lacing through eyelet holes worked (or clinched, if metal) in every seam through the double part. For waterproofing use ordinary paint containing ochre, or one of the earth pigments in preference. Lampblack is also good, but does not reflect the sun's rays as do lighter colours. For the first coat use equal parts of boiled and raw oil and a little turps, and allow plenty of time to dry; omit raw oil in the last coat, and omit the pigment in the first. If it is not possible to make the cover with seams athwart, let them be fore and aft (not diagonally), and work a tabling for the eyelet holes.

Staining Kid Gloves and Shoes Brown.—For a light brown stain, use Bismarck brown or annatto; for a dark brown, use acid brown. Make a strong solution of these in water, add a small quantity of ox gall to make them penetrate the leather better, and brush on. Gloves should be fixed on a wooden hand and dried on it. Boots that have been polished will not take the stain; they should first be thoroughly cleaned with turpentine.

Cage for Starling or Song Thrush.—The cage should be 2 ft. long, 18 in. high, and 11 in. wide, and provided with a false bottom covered with zinc; water and the scrubbing brush can then be used at cleaning time. There should always be plenty of sand on the bottom. In the accompanying sketch, the ends of the cage are of wire; at one end a food box or hopper is placed, and at the other end is a similar box containing the drinking vessel. These boxes should be made partly of glass, so that their contents can be seen without lifting them down. The door is in front. The position of the three perches is also shown. If the ends are of wood, both food and water vessels would be placed in front, one on each side of the door. This form of cage is better for keeping away draughts. In either case let the top project well over the ends and sides, say about $1\frac{1}{2}$ in. Give three coats of oil paint outside, and lime-wash the inside.



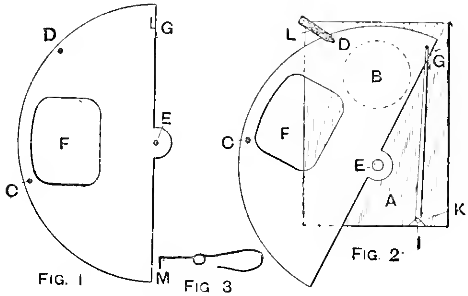
Cage for Starling or Thrush.

Brewing Ale.—If it is required to brew about 9 gal. of ale, take 40 lb. of malt and 10 gal. of water and raise nearly to the boil in a copper; after about an hour, run through a fine sieve into a large bowl. At the same time boil $1\frac{1}{2}$ lb. of hops in about $\frac{1}{2}$ gal. of water in an enamelled or earthenware pan for an hour, strain, and add to the malt infusion. Allow the liquid to cool down until it is hardly warm (*i.e.* to 70° F.), then take out about a quart of the liquid and stir it with about a pint of fresh brewer's yeast; add the mixture to the liquid in the bowl, stir well, cover, and allow to stand for twenty-four hours; then strain through a very fine hair-sieve, to remove the yeast, and bottle up, leaving it for a week or two to brighten and become brisk. Salt may be added after boiling, say $\frac{1}{4}$ oz. to 1 oz. Sugar is not needed unless very strong ale is required, and no finings are necessary unless the materials are bad or the brewing carelessly done.

Dyeing Sheepskins.—The following are instructions on dyeing sheepskins black, grey, and brown. After the skins are dressed and softened they should be placed in the hot dye, wool downwards, and allowed to remain for an hour or two. They should then be washed in cold water, and hung up to dry till the next day. They should then be put into the hot fixing solution, allowed to remain an hour or two, washed in cold water, and hung up to dry. As it is only necessary to immerse the wool in the solutions, some strips of wood can be placed along the bath containing the dye to prevent the skin sinking. Take great care that the solutions are hot when used, and, during the drying, frequently shake the skins and rub them to prevent them drying hard. For a black, boil $\frac{3}{4}$ lb. of copperas, 2 oz. of sulphate of copper, and 1 lb. of cream of tartar in 1 gal. of water. This is the fixing bath. The dye is made by boiling 5 lb. of logwood in 1 gal. of water. For a grey dye, boil $\frac{1}{2}$ lb. of logwood in 1 gal. of water; for the fixing bath, boil 2 oz. of copperas in 1 gal. of water. To make a brown dye, boil 1 lb. of catechu in 1 gal. of water; and for the fixing bath, boil $\frac{1}{2}$ lb. of sulphate of copper in 1 gal. of water. These proportions may be varied according to the tint desired. The operations may be repeated if the colour is not intense enough. Experiment first upon a piece of skin.

Distilling Lavender Water.—In distilling lavender water, a copper or glass still and a condenser will be required. The lavender flowers should be placed in the still, covered with water, and then heated; the water distilling over will contain the essential oil of lavender, and may be used as lavender water. The water may be cleared by shaking it with a little fuller's-earth, allowing the latter to settle out, and then decanting from the deposit.

A Cheap Photographic Shutter.—The following instructions are on making a cheap photographic shutter for a quarter-plate stand camera. In a piece of wood (A, Fig. 2) cut a hole B to fit the lens. This may be made to fit directly on to the lens tube with the hood removed. Cut from thin, perfectly flat metal a piece of the shape and size of Fig. 1, and make in it small holes C, D, E, and a large opening F. Cut and turn up a piece at G to form a hook for the elastic band H. Fasten this to A by a pin through E, and



A Cheap Photographic Shutter.

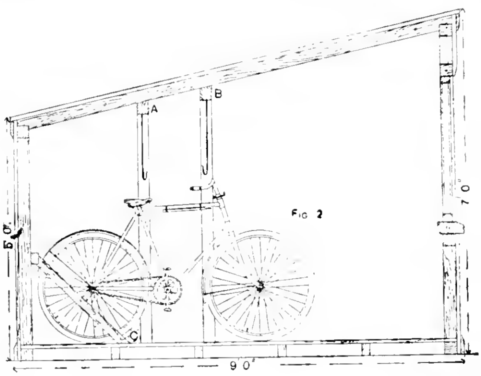
place a stop—a triangular piece of wood—at I, and through it a hook of wire K. Now form the catch shown in section in Fig. 3, and fasten firmly with a staple at L. The lower part acts as a spring and keeps the point M (Fig. 3) tight in the hole D. To set the shutter, pull it round till the point M catches in D, as shown in Fig. 2. To release the shutter, press the spring catch. If the spring is lightly pressed, the point M will be arrested by the hole C, and the shutter will stop half-way for a time exposure. For different exposures, different bands must be used to vary the strength of the pull.

Softening a Goat's Skin.—An Hungarian goat's skin which has been cleaned, but has dried very stiff, may be softened by the following method. Well damp the skin on the flesh side and, when thoroughly soft, stretch it in all directions; then hang it up to dry in the shade. After an hour or so, take the skin down, give it a good shaking, and well rub it (similarly to washing clothes), then hang it up again, but by a different part to which it was previously hanged. After another hour or so, repeat the rubbing, shaking, etc.; then hang it up again. The more thoroughly the rubbing and shaking are done the softer the skin will be. When nearly dry, hand-rub the skin till dry, and it should be as soft as chamois leather.

Making Liquid Gum.—Liquid gum is often put up for selling in penny bottles. For this purpose gum arabic, costing sixpence and upwards per pound, is suitable. Gum dextrine may be used, but a large quantity is required to yield a good gum solution, and, moreover, it is usually dark coloured. A good gum may be made by dissolving 1 lb. of gum in 2 lb. of water; a poor gum by using 4 lb. of water. The former would yield 46 oz. (or forty-six penny bottles), and the latter 76 oz. (or seventy-six penny bottles), allowing for waste. The addition of a few drops of carbolic acid prevents the gum becoming mouldy. The gum should be covered with the water, and stirred till dissolved, no heat being required.

Making Flat-bottomed Punt.—To bend the sides to make them meet the stem- and stern-posts of a flat-bottomed punt, 17 ft. long, and supposing the sides to be 18 in. deep, boards of that width will suffice, as the desired sheer and rocker will be gained by the bending, more or less as the sides of the centre mould are more or less inclined. Having shaped the two sides alike, mark accurately the centre of each and draw a line through these and square with the edge. To this line screw the mould, keeping the edges of the boards quite level. Get four pieces of wood 2 ft. long and about 2 in. by 2 in.; use two of these at each end, placing them outside the boards vertically; lash the projecting ends of these battens together across the punt. By tightening at top or bottom, the desired shape can be gained. A small tackle is handier than lashing, but in either case it is well to keep a loop of stout rope round the ends during the process (if at either end the boards are to be drawn up close), to prevent personal accident, should the battens slip off or tackle or lashing break, etc.

Shed for Storing Cycles.—Fig. 1 shows the plan of a shed for storing about twenty cycles, Fig. 2 is a cross section, and Fig. 3 is a portion of the front. A simple arrangement for keeping the cycles in position by means of two inclined pieces of wood is shown at C (Fig. 2). An alternate arrangement for hanging the cycles on two hooks is also shown. To support the hooks, two pieces of wood about 3 in. by 3 in., going the whole length, must be fixed to the rafters, as shown at A and B (Fig. 2). These would require supporting by two pairs of uprights for the length of the shed, otherwise the weight of the cycles would soon make the roof sag. Wood 3 in. by 3 in. will be found most serviceable for the general framing, and $\frac{3}{4}$-in. matchboarding for the sides and ends. The roof may be boarded and felted, or covered with corrugated iron.



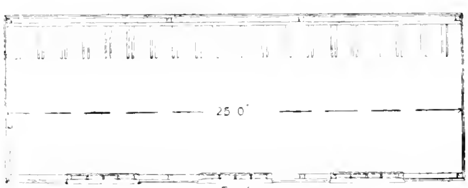
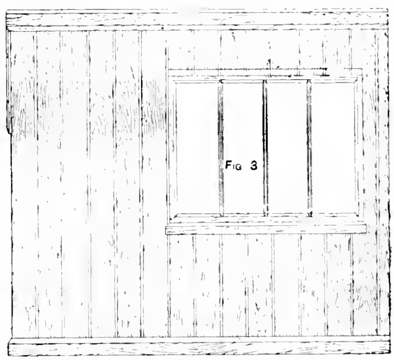


FIG 1



Shed for Storing Cycles.

Printing Qualities of Photographic Negative.—Rapidity of printing is governed first by the density of deposit on the plate; secondly, by the colour of the deposit. This difference in the printing rapidity of negatives exercises a great influence on the tone or contrast of a finished print. A yellow negative gives a much harder result, whilst it is impossible to get a rich purple tone from a thin bluish negative. A bluish negative, or freedom from stain, should be aimed at. Yellow stain is due to the oxidation of the pyro, and may be removed immediately after fixing by placing for a few minutes in a 5-per-cent. solution of hydrochloric acid; afterwards, as this has a tendency to cause frilling, passing through the alum bath. This treatment is, however, useless after the negative has once dried. In this case thiocarbamid may be tried, or the negative may be intensified with mercury and soda sulphite. The negative will, however, with the latter treatment take almost as long as before. If plenty of soda sulphite is used in the developer (that is, mixed with the pyro and not with the soda, as often recommended), there should be no fear of yellow stain.

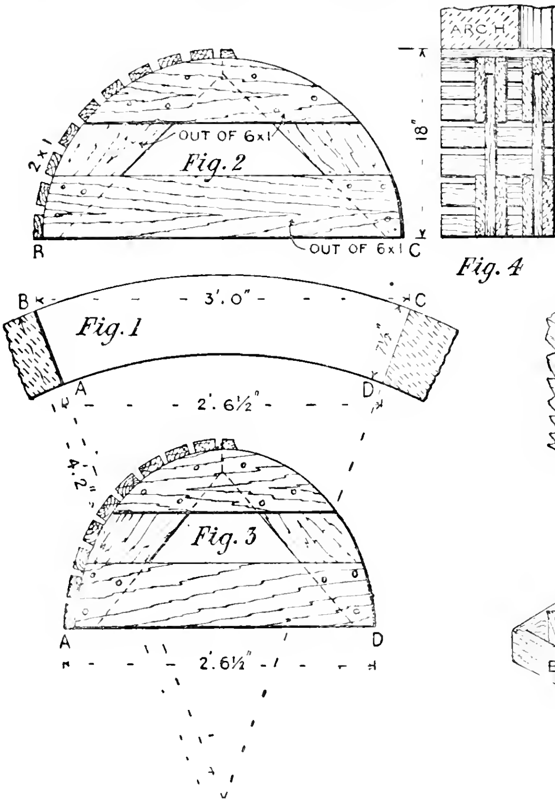
Particulars of Potash.—There is, properly speaking, only one kind of potash, and this is the oxide of the metal potassium. The name potash was first applied to the ashes formed by burning plants, this being done in pots; after purification by dissolving in water, filtering, and evaporating to dryness, the product is known as pearlash, and is an impure kind of carbonate of potash. American potash is really a pearlash, and is used with vandyke brown for brown stains. The name potash is often applied to caustic potash. There are several salts of potash used for staining purposes; bichromate of potash is used for staining mahogany darker, chromate of potash yields a yellow stain, permanganate of potash a brown stain, and ferrocyanide of potash (yellow prussiate) with an iron salt yields a blue stain.

Calculating Strength of Struts.—Gordon's formula is the best in a general way for calculating the area of struts or pillars in iron or wood:—f = intensity of pressure to crush short column of the material in tons per square inch; a = constant deduced from experiments on actual breaking weight of long columns; h = least transverse dimension in inches; l = length of pillar or strut in inches; P = total pressure on pillar in tons; p = pressure per unit of sectional area tons per square inch; S = total sectional area in square inches; $p = \dfrac{f}{1 + a\left(\frac{l}{h}\right)^2}$, or $P = \dfrac{fS}{1 + a\left(\frac{l}{h}\right)^2}$. Factor of safety, say, from 6 for short pillars to 10 for long pillars; f = 36 for cast-iron, 16 wrought-iron, 26 mild steel, 2·5 fir timber, 3 oak timber; a = for timber $\frac{1}{250}$ for square or rectangular sections, $\frac{1}{187}$ for circular sections merely flattened at ends take $\frac{3}{4}a$ in the formula, when rounded one end and fixed the other take $\frac{9}{16}a$, and rounded both ends $\frac{1}{4}a$; a = for wrought-iron or mild steel, $\frac{1}{3000}$ for solid rectangle, $\frac{1}{2250}$ for solid cylinder, $\frac{1}{4500}$ for thin round tube or pipe, $\frac{1}{1500}$ for angle with equal sides, and $300\,\dfrac{S}{S + b}$ for rolled joist section where S = sum of flange areas and b = area of web; when rounded or jointed at ends take $\frac{1}{4}a$; a = for cast-iron, $\frac{1}{400}$ for round hollow pillars ends flat and fixed, $\frac{1}{500}$ for H-section, $\frac{1}{400}$ for cross (+) section. It will be found of service to get an approximate section first, and then to calculate by the formula to ascertain if it is strong enough. For this purpose a fir post may be considered capable of sustaining safely 4 cwt. per square inch, or failing with 2 tons per square inch, and an oak post 6 cwt. and 3 tons respectively. A round cast-iron hollow column with a thickness of $\frac{1}{12}$ diameter may be safely loaded to 5 tons per square inch up to 10 diameters long, 4 tons from 10 to 15, 3 tons from 15 to 20, 2 tons from 20 to 25, $1\frac{1}{2}$ tons from 25 to 30, and $\frac{3}{4}$ ton from 30 to 35.

Mixing Oxide Paint for Brickwork.—Red oxide for painting on outside brick walls should be mixed with raw linseed oil and a little patent driers; see that the walls are thoroughly dry before painting them. Boiled linseed oil should not be used, as it tends to become brittle in time, and the moisture in the bricks would make it peel off. It would perhaps be best first to cover the brickwork with raw linseed oil only, so as to get a grip and to stop the suction, then finish with the oxide paint.

Preventing Lamp Wicks from Charring.—Stemp's patent wick is said to be practically fire-proof, and not to char. To produce this wick, to every gallon of water add 2·14 oz. of boric acid and 3·22 oz. of strong liquor ammonia. Dip the new wick in the mixture, and dry. A little dye added will enable the dipped wicks to be distinguished from the undipped. By another method a piece of carbon is fixed on the top of the wick. The cotton wick supplies the oil to the carbon, and the latter is lighted as usual; and, obviously, cannot char. File a small piece of carbon to fit the wick tube of a flat-wick burner with as little shake as possible; attach a piece of clean cotton wick to the carbon, and try the effect.

Centre for Circle-on-circle Arch.—A circle-on-circle arch is false construction, and should only be adopted in exceptional cases. When it is a case of necessity, a semicircular arch of 3 ft. span may be turned in a 7½-in. stone wall curved to a radius of 1 ft. 2 in. A

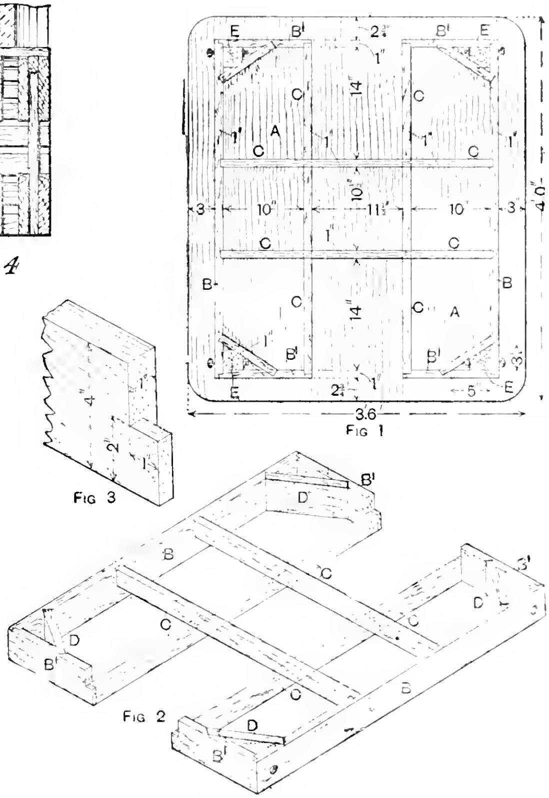


Centre for Circle-on-circle Arch.

template A B C D (Fig. 1) should be set out on the plan for the base of the centre, and the outside B C being a semicircle the framing may be set out as in Fig. 2, being flat on face like an ordinary centre; allowance is made for the thickness of the laggings, which are 3 ft. over all. The back A D will be the same height (18 in.), but only 2 ft. 6½ in. wide, and therefore elliptical, as in Fig. 3. The laggings, when nailed on, will form a flewing surface upon which the voussoirs or bricks may be laid. The supports for the centre would be the usual ones, the overhang not being sufficient to necessitate any exceptional course being adopted.

Keeping Qualities of Photographic Developer.—Pyrogallic acid and soda carbonate solutions will not keep many minutes; decomposition sets in directly the two are brought together. The pyro solution (No. 1) prepared with nitric acid and a small quantity of water will keep good for several months, but the acid should be added first. Sulphite of soda may also be added to the pyro as a preservative, as follows. Take 8 oz. of sulphite of soda (a fresh sample should be used, as after slight exposure to air it becomes sulphate and is useless) and dissolve in 30 oz. of hot water to which has been added twenty drops of nitric acid. The soda solution (No. 2) may be prepared by dissolving 6 oz. of washing soda in 30 oz. of water. For use, take 1 oz. each of No. 1 and No. 2 and add 3 oz. of water. This is sufficient for a whole plate. When using the alum solution, fill the dish to within about ¼ in. of the brim; this may be used till it becomes discoloured (say for five or six plates). The same quantity of fixing solution will fix three or four plates. It is not advisable to use it for a greater number, because the hypo becomes charged with silver and does not do its work so rapidly nor so well.

An Easily Made Kitchen Table.—The kitchen table here illustrated is made without mortising. It has detachable legs and a solid top, the latter being made from a yellow deal board 16 ft. long and 11 in. wide, cut into 4-ft. lengths, which, when tongued, planed, and glued together, make a surface 4 ft. by 3 ft. 6 in. (see Fig. 1). A floor board, 11 ft. by 6 in. wide and 1 in. thick, will be required for the framework underneath. The board is cut lengthwise into two pieces 4 in. and

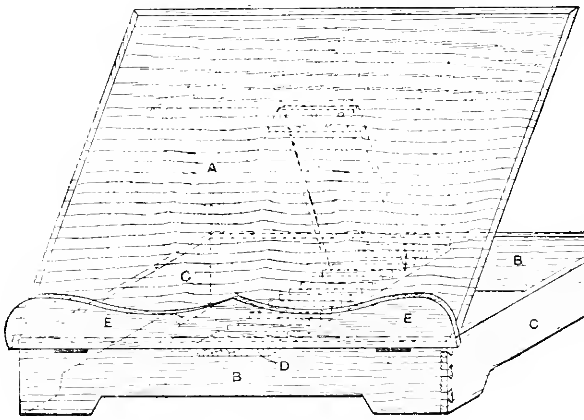


An Easily Made Kitchen Table.

2 in. wide, for the sides B and the cross-pieces, or stays, C (Figs. 1 and 2). The 4-in. piece is cut into two pieces 3 ft. 6½ in. long, four pieces 11½ in. long, and four pieces 8 in. long. The 2-in. piece is cut into two pieces 34 in. long, and two pieces 41¾ in. long. A set of 2½-in. table legs, four table screws, 4 in. long, fitted with washer and screw-plate, two dozen 1½ in. and one and a half-dozen 2-in. screws, are all that are necessary in addition to the two drawers, which can be made from a second-hand box, to fit the spaces left in the frame, to complete the table. To put the table together, first rebate together the two side pieces B and one end of each of the four end pieces B', as shown in Figs. 1 and 2. Then the other ends of the pieces B are cut as shown in Fig. 2, to fit the ends of the long cross-pieces C, which form the bearings for the runners of the drawers; 2 in. of the projecting half is cut off to allow for the drawers. Then fix together by glue and screws, and place the two long cross-pieces in position, and insert the two short cross-pieces in the sides to the extent of about ½ in., as shown in Fig. 3. The legs E, which are 2½ in. square, are secured by means of four table screws and the 8-in. pieces D, as shown in Fig. 1. The drawers are 14 in. long by 11½ in. wide, and run on pieces of wood 14 in. long and 1 in. square.

Marbling a Stone Mantelpiece.—Wash the mantel with a mixture of lime water and common washing soda, to remove any trace of grease or smoke. Swill off with clean water. For white marble, apply one or two coats of quick-drying white paint. The dark veins may be put in with sticks of willow charcoal, or with thin black paint and a camel-hair brush, the harshness of such veins being tempered by brushing over while still wet with a badger softener or clean soft dusting brush. An alternative plan is to apply over the veinings a very thin coat of white paint, having just sufficient body to make the veins appear underneath. A very pale varnish must be used. For black marble, quick-drying black must be applied for the groundwork; the veins are of a green and whitish-green tone; and the colours are blended together by passing the badger softener across. Ordinary oak varnish will do for the latter class of work. For better-class work, the colours should be worked up thin and scumbled on with a piece of sponge; spotting being done by taking up plenty of colour in a brush and tapping it against a stick; the colours should be nicely blended and all harshness avoided.

Making a Portable Book-rest.—The book-rest here illustrated can be set at any angle desired; when closed, it resembles a bottomless box, except for the ledge E. The following pieces of wood will be required. Two pieces (B, B), 12 in. by 2 in. by ⅜ in.; three pieces (C, C, and D), 9 in. by 2 in. by ⅜ in.; one piece (E), 12½ in. by 2 in. by ⅜ in.; one piece, for the support (shown dotted), 7 in. by 2 in. by ⅜ in.; and one piece (A), 12½ in. by 9¼ in. by ⅜ in.; these are all finished sizes. A brass book and screw eye, three pairs of 1-in. hinges, and a few round-headed brass screws will also be required. First cut the pieces B and C to the shape shown (cutting pieces out of B to receive the rack D), and dovetail together. The rack D must be notched out as shown to receive the end of the support, which is hinged about 2 in. from the top of A. The book-rest (A) is hinged to the front piece B. The ornamental ledge is secured to the front of A by means of glue and screws.



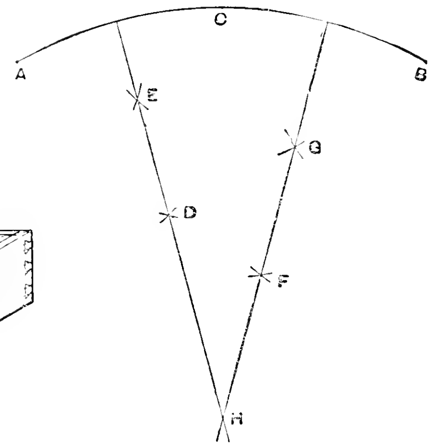
A Portable Book-rest.

Weight and Covering Capacity of Granite Macadam.—The weight will depend upon the specific gravity of the granite, and the closeness with which the material is packed together; as ordinarily thrown together after breaking, the voids will be from 25 per cent. to 33 per cent. of the whole, and the weight of a cubic yard will be from 27½ cwt. to 30 cwt. A waggon 12 ft. 8 in. by 5 ft. 8 in. by 1 ft. 10 in. will contain 4 cub. yd., or from 6¾ tons to 7½ tons. The probable weight may be ascertained by filling a water-tight box with the macadam, and pouring in measured quantities of water until all the voids are full. The cubic contents of the water ÷ cubic contents of the box = percentage of voids. The weight per cubic foot of the granite being known, it is easy to calculate the weight of a cubic yard of macadam.

Soldering Astragals and Tacks on Lead Soil Pipes.—For the astragals, a pattern of the design is first made in wood, and from this a print is made in damp, loamy sand, in which molten lead is poured to form a casting. If many are required, the wood pattern should be sent to a foundry, and a flask made in gun-metal, from which any number can be cast. These do not require so much cleaning up to make them look smart as those cast in sand. For fixing them to the lead soil pipes the back sides are tinned with a copper bit, and also corresponding parts on the pipes. The astragals are then folded about three parts round the pipe, and 9 in. apart, and "sweated" on by means of a blowpipe. If this is neatly done, no solder will be visible. The tacks, if plain, should be cut out of 8-lb. sheet lead, about 9 in. square, the edges trued and trimmed, one end soiled 3 in. and shaved 1 in. wide; corresponding spaces for a pair of tacks, prepared on the soil pipe, between the astragals and soldered seams, are then wiped or floated with metal and a plumber's iron. Cast-lead tacks have an advantage, as the nail holes are strengthened by having an extra thickness of the metal round them.

Removing Old Paint from Venetian Blind Laths.—This is a cheap method of removing old paint from Venetian blind laths. Place 1 stone of well-burnt lime in a large bucket and slake with hot water; add 7 lb. of common soda, and stir the whole together until the soda is dissolved. Lay this solvent over the laths about ⅛ in. thick, and allow it to remain about two hours; the paint can then be easily scraped off. Thoroughly wash off with clean water and dry. Coat the laths with vinegar before re-painting.

Determining Centre of Circular Arc.—The accompanying illustration shows one method of finding the centre of a circular arc where it is possible to strike arcs for intersections on one side only. A, B, and C are any points on the curve. Then with any radius in the compass, and with centres at A and C, strike arcs that intersect at D. Similarly, with another radius, strike arcs that intersect at E. Similar intersecting arcs at F and G may also be drawn, using C and B as the centres; then a line joining E and D and produced, if necessary, will cut the line joining F and G produced, if necessary, in H, the centre required.

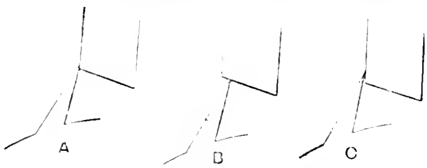


Determining Centre of Circular Arc.

Removing Oil Stains from Stone Step.—If the stains are but surface ones, make a paste of fuller's earth and paraffin oil, and lay this in a thick coating upon them; allow it to remain a short time, then wash off. Should this treatment not remove the stains, rub them with fine sharp sand and water, using a piece of hard wood in the same way as a brush until the stains disappear.

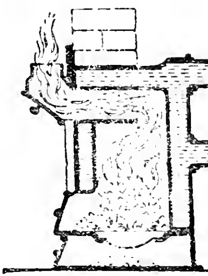
Shading Marqueterie Inlays.—To produce the shading seen in Sheraton inlays, very fine sand is heated in an iron pan placed upon the top of a stove, the heat being slightly greater than can be borne by the fingers, but not so hot as to char the veneers. Practice is required to prevent an abrupt edge, the gradations of tone being gained by holding one end of the veneer in the sand longer than another part. As the sand is generally hottest in the middle of the pan, the dark or nearly black tones are gained by placing the veneer in the sand at that point. If the veneer is small, it should be held with a pair of pliers or tweezers. The work must be done before the marqueterie is made up. The foregoing is an old-time method, and is now being supplanted by pyrography or poker work, which is closely akin to etching, as it allows the work to be touched up after the veneers are fixed into position.

Depthing Watch Lever Escapement.—Escapements are "pitched" by putting the escape wheel and the pallets in a "depth tool" and adjusting them until correct, then transferring the depth to the watch plates by means of the compass points of the tool, and drilling the pivot holes at the points indicated. The roller depth is pitched by placing the roller on a small turning arbor in the depth tool with the lever. The pallet depth is correct when the wheel teeth just fall upon the locking faces of the pallets. If the teeth fall upon the impulse planes, the depth is shallow. This depth can be tested in the watch by holding the movement in the left hand with the tip of the forefinger on the balance. In the right hand hold a sharpened watch peg, with which press gently on the 'scape-wheel teeth, urging the wheel forward. With the forefinger of the left hand, slowly lead the balance round until a tooth just drops. Immediately let the balance go, and, if it has locked properly, the lever will be drawn sharply up to the banking pin; if it is too shallow, the lever will go back and the watch will tick rapidly. This requires some practice to test, but perhaps the above sketches will be helpful. A shows a tooth locked, having just dropped on to the pallet, and a correct depth. B shows a shallow depth, the tooth just missing the corner of the pallet and falling on to the impulse face instead. C shows a deep depth, the tooth falling too far on the locking face.



Depthing Watch Lever Escapement.

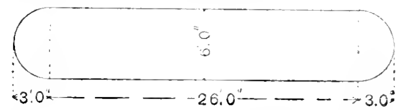
Heating a Small Greenhouse.—In heating a 10-ft. by 7-ft. span-roofed greenhouse, if an oil stove will not do, recourse must be had to a small boiler and hot-water pipes. Such an apparatus is made by nearly every boiler maker. It consists of a boiler just let into the wall of the house below the glass, the back of the boiler showing inside the house. The accompanying sketch shows such a boiler in section, and it will be seen that the flue pipe connection, and both feeding and stoking doors, are all outside the house, while the pipe connections are inside. The pipe connections and joints are simply made with rubber rings, and they terminate at the other extremity in a box-end, which acts as a supply cistern, support for the pipes, and air vent.



Section of Greenhouse Boiler.

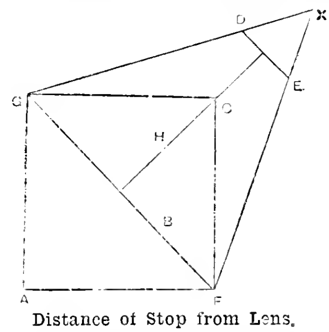
Making a Papier-mâché Mask.—In making a papier-mâché mask, tear into pieces about 3 in. square some good porous brown paper and soak the pieces in cold water. Then make sufficient good flour paste, mixing with it a little hot glue. When the paste is cold, it should be thick and tenacious. When the paper has been well soaked, squeeze the water out of it, paste the paper on both sides, and lay the pieces together in a heap to keep them moist. Masks are usually made from a plaster-of-Paris mould in the following manner. The mould is first lined with pieces of oiled tissue paper to keep the papier-mâché from sticking to the plaster; the pasted brown paper is then pressed into the mould piece by piece until the desired thickness of the mask is obtained. When partially dry the mask is lifted out, and when thoroughly dry it is ready for painting. Any number of masks may be made from the same mould. The model from which the plaster mould is made is generally cut from a wooden block, or it may be moulded in clay, or a cast may be taken from another mask. Place the model, previously rubbed all over with sweet oil, in the centre of a square wooden box large enough to allow 2 in. of plaster all round the model, and pour in the liquid plaster until the box is full. When the plaster has set, lift out the mould and touch it up if necessary by scraping with a sharp knife.

Determining Contents of Egg-ended Boiler.—When determining the contents of a boiler egg-ended as shown, it must be remembered that the boiler being circular in cross-section, the contents consist of a central cylindrical portion 26 ft. long, and two hemispherical ends that together make one sphere 6 ft. in diameter. The area of cross-section of the cylindrical portion is found by squaring the diameter (that is, multiplying it by itself) and then multiplying by ·7854. The contents will then be found if the area be multiplied by the length. Of course, all dimensions should be taken in like units, that is, in inches or in feet. Thus, in the example, the area of cross-section of the central portion will be 6 × 6 × ·7854 = 22·27 sq. ft., and the contents will be 22·27 × 26 = 579 cub. ft. The contents of a sphere can be determined by cubing the diameter (that is, multiplying the diameter by the diameter and the product by the diameter) and multiplying by ·5236. Thus the contents of a sphere 6 ft. in diameter will be 6 × 6 × 6 × ·5236 = 113 cub. ft., so that the total contents of the boiler will be 579 + 113 = 692 cub. ft. Since 1 cub. ft. of water contains 6·23 gal., the contents will equal 692 × 6·23 = 4,311 gal.



Determining Contents of Egg-ended Boiler.

Distance of Stop from Lens.—The correct distance at which a stop should be placed from a lens is that which would give the maximum of covering power with a minimum of distortion. If a cardboard stop is placed close against the lens and moved gradually from it the best position will readily be found, for it will be seen that as the stop recedes from the lens the sharpness spreads to the edges, but straight lines coming near the margins are bent outwards in the centre. The accompanying diagram shows another method of working out the correct position of the stop. Construct a square A G C F, the sides of which are equal to the focus of the lens. Draw the diagonal B and a line H equal to the focus. At the end of this line draw D E equal in length to the diameter of the lens. If lines are now drawn from F and G through E and D, the point where they meet X is the position for the stop.

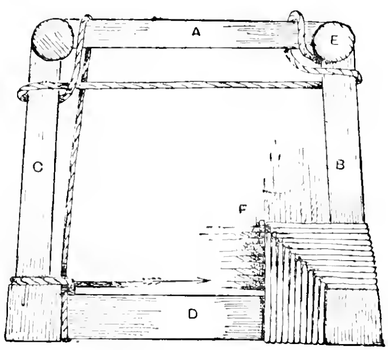


Distance of Stop from Lens.

Imitation Earth for Cases of Stuffed Birds.—Blocks of peat roughly cut to shape are fastened in the case with glue and nails. The whole is then covered with whiting made with thin glue instead of water. It is coloured with oil colours, and grasses, etc., are fixed. Another and better method is to form a light foundation with strips of wood, to which are attached cardboard and brown paper, and the spaces filled with shavings, small pieces of thin paper being pasted over all joints and angles. By this means the groundwork can be built to any shape or size, and there is less likelihood of introducing insects. The groundwork should be left for a day, then covered with glue and whiting. When dry, it is covered with thin glue and fine sand forcibly thrown on. Lastly, it is coloured to taste by flooding on thin paint.

A Method of Soldering Aluminium.—First procure a small piece of thin sheet aluminium, say about 1 in. square, and roll it into a little coil; next procure a wooden penholder and place the roll of aluminium in the hollow end of the penholder, leaving about one-half out, and give the end that is out of the holder a light blow or two to flatten it. Clean the aluminium article at the place of the joint by rubbing with fine emery cloth, or by scraping with a knife; heat the article to be soldered to the melting point of the solder in any convenient way, say on the top plate of a kitchen range, or over a Bunsen burner with a piece of sheet iron placed thereon. Then place it on the table or work-bench on sheet asbestos to prevent burning the table; and when hot, sprinkle on the flux and rub with the little aluminium tool, which tins the surface very easily. While the article is still hot apply the solder, and guide the flow with the narrow edge of the tool; then remove the article and allow it to cool to produce a very strong and perfect joint. No soldering iron, blow pipe, blow-lamp, or special apparatus is required by this method. Here is a recipe for a special hard aluminium solder for cycle, or any special work. Aluminium, 70 per cent.; tin, 20 per cent.; and silver, 10 per cent. This hard solder is worked with the same process as that described above, but requires a little higher temperature.

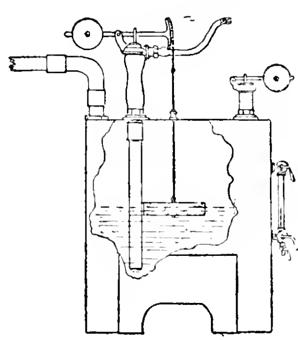
Re-seating Chairs with Rush or Cord Bottoms.—First carefully remove the four thin battens which are nailed on the edges of the seat, and pull off the old rush, dust, etc. The sides of the seat frame are slightly sunk below the corners, so that the work will be flush with the latter when finished. The work is very simple, and proceeds from one corner regularly round to others in succession, terminating in the centre, so that all four sides are worked together, as will be explained in the above illustration. A, B, C, D, are the sides of the seat frame. Have a good coil of cord on a stick, and make the end fast to the leg E (right-hand back corner), pass the coil up and out over A, then up and out over B, over C and up and out over A, then over D and up and out over C, etc. This will be quite clear from the cord shown loose in the illustration. When pulled up snug and tight and as the work proceeds it will have the appearance at each corner of that at the corner F. Any joining of the cord or rushes must, of course, be done after a back turn, so that it will come underneath. Stuffing can be pushed in between the upper and lower layers of cord as the work proceeds, and the end which is first hitched to the leg can be knotted and afterwards cut off.



Re-seating Chairs with Rush or Cord Bottoms.

How to Work up Bromide Enlargements.—For working up bromide enlargements the following articles are required. A No. 2 or No. 3 sable brush, blue and ivory black moist water-colours, a tuft of cotton wool, a few paper stumps, some powdered blacklead (the block used for sharpening the retouching pencil upon answers very well), a small piece of opal for the palette, and a stick of ink eraser. Place a small quantity of ivory black on the palette, mix well with a filtered solution of gum arabic in water, and add a trace of blue to match the colour and surface of print, the surface being usually a little glossy. First carefully spot out all the large patches and defects. Remove any black spots by scraping with the retouching knife, the edge of which should be exceedingly keen, but slightly turned over. Proceed then to model up the face—that is, to soften or brighten the light and shade, toning down defects, heightening the lights on certain good features, or those requiring greater prominence. The lightening is done by rubbing with the eraser, or by scraping with the knife and fining up with the brush and colour. The lights generally require bringing up to a focus. Improving the expression must be done very skilfully, or is better left undone. Keep the paint on the palette moist and the brush sufficiently full, and work with long, sweeping strokes across the muscles. The deepest shadows in the dress, etc., generally require strengthening, but outlining, etc., should be avoided. Never work without a guide (*i.e.* a print from the negative before retouching). The background should be kept subdued; any obtrusive lights may be "hatched" out with the brush, or rubbed out with powdered lead or chalk (or both mixed) on a stump. Lastly, if the picture is a vignette, it is often advisable to work in a cloudy effect around the head, as the vignette, even when skilfully made, with a light background, is apt to show too decided a shape. To do this, take up some powdered lead on a tuft of wool, and rub hard on a sheet of rough paper. Having got it to work smoothly and free from grit, rub all round the vignette until it softens off, so that its shape could not be determined. Clouds may then be scraped in with the eraser.

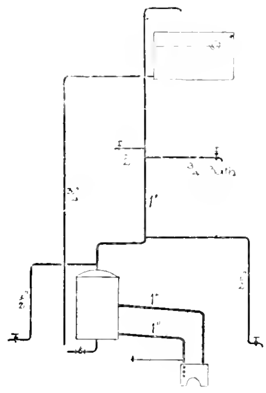
Boiler System for Steam Cooking.—The sketch herewith shows a boot boiler, such as would go at the back of a range fire. All the fittings are on it, namely, safety valve (set to blow off at 5 lb. to 7 lb.), automatic water inlet valve with stone float, water-gauge, and the steam supply pipe that conveys the steam to the hot plate or other utensil. The water-supply valve must be fed by a water service having a water pressure in it exceeding the steam pressure named; that is, the cistern which the service comes from must be at least 18 ft. to 20 ft. above the boiler, otherwise, although the valve may open at the proper moment, no water will enter if the steam is strong enough to hold it back. When the boiler has to be recessed out of sight behind the range covings, recourse is had to a supply cistern to carry the fittings. This cistern has a steam-tight lid, and all the fittings are put on it as a rule, though some still prefer to put the safety valve on the boiler and bring it to the front by means of a short pipe. Between the boiler and the cistern are two pipes, one above and one below water level. The latter is the cold supply, while the former is an equalising pipe to prevent the steam emptying the boiler by forcing the water back into the cistern. The steam service is taken direct to the hot plate, rising as far as it can, then (if necessary) falling the rest of the way. There must not be any dip which would harbour condense water. The utensil must have a cock to discharge the condense water as it collects. This cock is at the bottom of the utensil, while the steam supply is usually taken in at the top. These goods and the boilers do not as a rule figure in makers' lists, as they are almost invariably made to order to meet customers' requirements as to measurements, etc.



Boot Boiler for Steam Cooking.

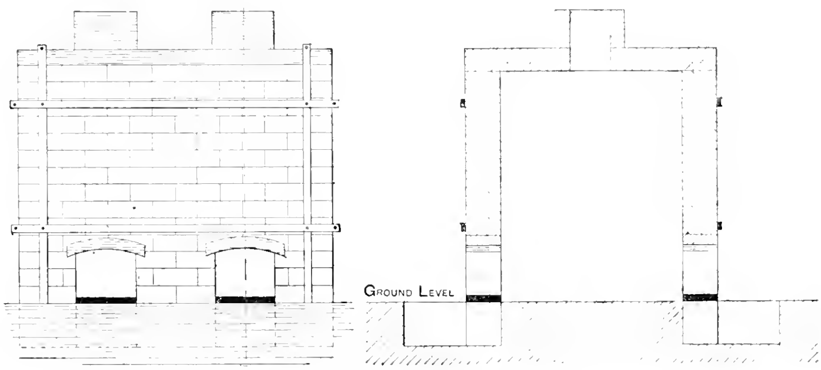
Galvanising Iron and Steel.—In the earlier processes of galvanising iron and steel the zinc was deposited upon the metal by electrolysis, but the hot-bath process in most galvanising establishments has entirely superseded the electro process. In the so-called galvanising process, the iron is first immersed in hydrochloric acid to render it perfectly clear and free from scale. It is then immersed in molten zinc, the surface of the molten metal being kept covered with powdered sal-ammoniac, this salt possessing the property of dissolving the oxide from the surface of the molten zinc, and also aiding the adhesion of the molten zinc to the iron surface. If the iron has a slight coating of tin, and is then coated with zinc, the zinc coating is said to adhere more firmly and does not scale when the metal is being worked.

Simple Hot-water Apparatus.—The dimensioned sketch shows a simple hot-water apparatus, with cylinder, to meet only a moderate demand for hot water to supply bath, lavatory, and two sinks, such as exist in a moderately small house; a saddle boiler in a 9-in. fire (boiler about 11½ in. wide), with a 20-gal. cylinder, should be large enough. The accompanying sketch shows the other particulars. If a stopcock is put in the cold-water service it must have a full-way through it. The small draw-off below the cylinder is an emptying service.



Simple Hot-water Apparatus.

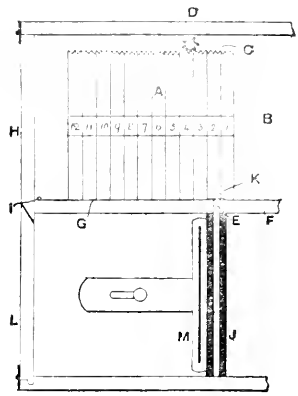
How to Build a Small Brick Kiln.—A brick oven about 5 ft. by 4 ft. by 4 ft., conforming to the sketches below, may be built of fire-bricks, with walls 6 in. to 9 in. thick, puddled with fireclay and covered either with stone slabs or with a corrugated iron sheet. If stone slabs are used, then two openings must be cut to serve as chimneys for the escape of steam and hot gases. One end of the kiln should be left open for charging purposes, and a temporary wall may be built before firing and removed again after the bricks are burnt. Iron tie-rods should be used to keep the kiln in shape. There are four fire-holes in the kiln, two on each side; the firebars are fitted at the level of the ground, the ash-pits being below the ground level, and the ground must be excavated along each side of the kiln so as to reach the ash-pits. The firebars are placed at the level of the ground so as to get efficient heat at the bottom of the kiln, and the bricks must be so set in the kiln that they tend to carry the flames to the centre of the kiln as well as up the sides.



How to Build a Small Brick Kiln.

Pneumatic Test for Drains.—The pneumatic test for drains was introduced in the early 'eighties, and consists of plugging all the drain openings and filling them, as well as the manholes and soil pipes, with air under a slight pressure. The test is troublesome to apply in a thorough manner, and defects and leakages are not localised by it. The smoke test is far preferable, as by it defects are more readily traced to their position by the senses of sight and smell.

How to Change Plates in a Hand Camera.—One of the most convenient methods of changing plates in a hand camera is to have a double chamber. In the top chamber B a magazine A moves backwards and forwards by rack C and pinion D over an opening E in the floor F, through which the plates may be dropped for exposure in any order. The opening is covered by a sliding piece K, pulled out from the side. The magazine consists of a grooved box made in zinc, with a sliding lid or bottom G. It is inserted into the top chamber through a light-tight door H, the lid underneath, which is bolted to the floor at I, so that as the magazine is racked forward towards the opening the lid is pulled off. Strips J are placed at the sides to guide the plate and keep it in correct register. After exposure the camera is turned upside down, and the plate falls back into the magazine. Numbers corresponding to the grooves, or plates, are placed along one side of the magazine, and may be read off through a little ruby glass window at the side. Focussing may be done by opening the door L and pushing the screen M into register. The only objection to this pattern is its bulk.



Arrangement for Changing Plates in a Hand Camera.

Lettering in Relief with Gold on Wire Blinds.—The raised effect is obtained by gesso treatment, generally with the aid of stencil plates cut from millboards. Alabastine is probably the safest material to use, although the relief may be produced by a mixture of plaster-of-Paris and weak size. Of course, the surface must be rubbed down and prepared in the usual manner with gold-size before gilding.

Powdering Brass Spelter.—To powder brass spelter, either granulate by pouring the metal into a stream of water running at high pressure, or pound in a mortar quickly while the spelter is just under its melting point.

Preparing Lavender Water.—In making lavender water, the lavender flowers are placed in a still with water, and heated. The water which distils over carries with it the essential oil, which is then separated from the water. To make lavender water, the oil of lavender is dissolved in spirit of wine in the proportion of about ½ oz. to the pint. A large quantity of the flowers is required, and unless the work is to done on a big scale, it will be better to buy the oil and dilute it as described above.

How to Make a Small Wheelbarrow.—The barrow here described is shown complete by Fig. 1, Fig. 2 being a plan of the bottom frame. The ash hales H (Fig. 2) are 3 ft. 1 in. long and 1⅝ in. deep by 1½ in. thick. The handles rise 3¾ in. above the level of the under side of the hales. Leave not more than ⅝ in. on the faces of the hale tops, or they will look heavy. Dress out ¾ in. on the face of the hales, and ¼ in. under the hales. The cross-pieces in the frame must be of oak, with the edges dressed off underneath. Let the hind piece tenons, gauged ½ in. thick, come through the hales for 1¼ in. to support the legs as shown by Fig. 2. The hales and cross-pieces, when finished, should be pinned tight with $\frac{3}{16}$-in. wood pins. Then put on the legs, splayed at the top; they are 1½ in. square, and stand 1 ft. below the hales to suit a wheel 1 ft. high. Fasten the legs and hales with bolts 3 in. long, the heads showing outside. Not more than a ¼-in. shoulder must be made on the legs, as the front board can be levelled sideways only. Four stays must be used for the legs, two to go under the hales, as shown by Fig. 1, and two under the hind cross-pieces. Then put in the bottom board, of ½-in. red deal, as shown by Fig. 2. All joints should be painted. The bottom board overhangs the front cross-piece by ⅝ in. for a > dressing. Fit the sides to the hales; the front may lean beyond the square mark by 3¼ in. The sides being 9 in. deep by ⅝ in. thick, reduce the hind ends to 8¼ in. deep. The side front ends are > edged. Run a $\frac{3}{16}$-in. or ¼-in. bead on the edge; then fit the front board on top of the hales and bottom board. Let the front board, of ¾-in. red deal or elm, rise in a curve 1¼ in. above the sides. When fitted and dressed paint the joints, and nail the sides to the front board with 1½ in. cut nails; then screw on the ⅞-in. hoop iron, with ¾-in. round-headed screws. The iron that fastens the wheel to the barrow hale is ¾ in. broad by ⅛ in. thick, and long enough to go past the front cross-piece by 2 in. or 3 in. The ash or oak axle for the wheel is 8¼ in. long by 2½ in., turned down at the ends to 1½ in. for a ferrule 1 in. long; ⅜-in. round pins, driven in the axle ends, stand out 1 in. to enter the eye of the iron screwed under the hales. There are eight oak spokes ¾ in. broad by ½ in. thick, with four ash felloes 1¼ in. square and bevelled to suit a ¾-in. by ⅛-in. hoop, rounded on the insides. The four dowels for felloe joints are ¼ in. diameter. The wheel and barrow inside are painted red, and the barrow outside is painted light green, lined with lighter colour and black.

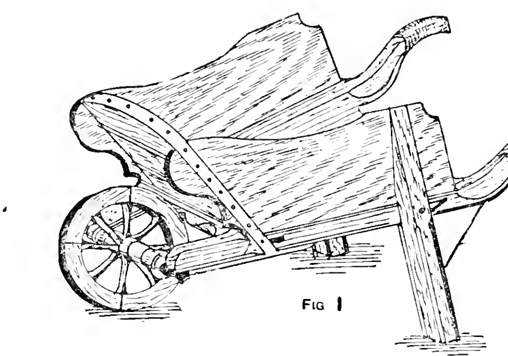


FIG 1

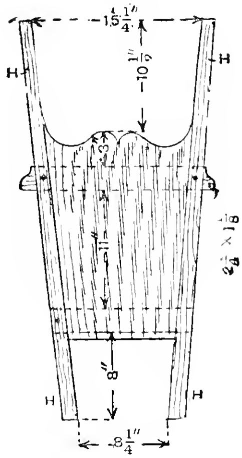


FIG 2

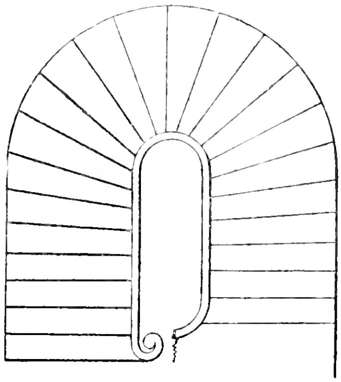
A Small Wheelbarrow.

Ridding a House of Ants.—In ridding a house of ants, discover the nests, and on the mouths of these drop some quicklime and wash it in with boiling water. Or camphor may be dissolved in spirit of wine, then mixed with water and poured upon the haunts. Tobacco water has also been found effectual. To drive the ants out of the cupboards, camphor, tar, creosote, or chloride of lime may be employed, but these substances cannot be used in the pantry. The shelves and floor should be scrubbed with carbolic soap. To catch the ants, cover some plates with a syrup composed of sugar and water, and place these plates in the infested places; destroy any ants found upon them by dipping the plates and contents into boiling water. When they are somewhat thinned by this means, try one of the methods given above; or place a mixture of sugar, beer, and arsenic on plates. Fly papers might also be tried.

Making Sailor's Canvas Bag.—In commencing to make a canvas bag as used by sailors, a double seam is sewn down the side of the bag, and it is then a canvas cylinder. To get the radius of the circle for the canvas bottom, measure the width of the bag while flat on a table and add 2 in., and divide by 3. Make a loop of twine to this size, stick a sail needle into a piece of canvas, and with pencil and twine describe a circle about 2 in. greater in diameter than the bag. Now shorten the twine 1 in. and make another circle, cut out the canvas bottom to the outer circle, turn in ½ in. of the edge of the bag and sew a round seam with needle and twine, keeping the doubled edge to the inner pencilled circle; turn the bag inside out, and flat-seam the bottom edge to the side; this makes a neater job, though the one seam alone will suffice. For securing the top of the bag, sew a leather strip on the top edge of the canvas just as braid is put on cloth; then to the side seam, just below the leather, sew a strap to encircle the neck tightly and fasten with a padlock, the strap being furnished at its ends with hasp, etc., to take the padlock; the leather edging cannot be pulled under the strap. Another plan is to sew a tabling or hem round the top edge, then sew canvas beckets about 6 in. apart round the neck, and through these pass the strap and lock as before. A piece of brass chain is sometimes used in place of the strap, the end links taking the lock. A strap with buckle can, of course, be used if a lock is not wanted.

Painting and Varnishing a Pony Cart.—The gloss on a pony cart is obtained by applying one or more coats of varnish after the colour and lines are put on, according to the quality of the work. For ordinary work, the body is prepared by lead colour and filling up, and rubbing down with pumice-stone and water, then giving a coat of light lead colour, which is faced down very lightly to take out the brush marks. The work is then ready for either two or three coats of ground colour, the first coats being made to dry medium quick, the last coat having a good portion of varnish added. Allow to stand for a couple of days to harden, then flat down with pumice-powder and a cloth pad, using sufficient water to make it work freely. This will leave a good surface for lining out on. After the lines are dry, the first coat of varnish may be put on. Before doing this, see that every particle of pumice-powder is washed off, freely using a water-tool to clean out the corners; then dry off thoroughly. Varnish in a dry, clean place, free from sudden draughts and kept to a temperature of 75° F. If a second coat is to be put on, the first one should not be too full, but sufficient to form a good foundation for the next one. After the work has been allowed to stand three days, it is flatted down in the same manner as the varnish colour, and another coat may be given to finish the job, putting this on as heavy as possible without getting runs or thick edges.

Balanced or Dancing Steps of Staircase.—The term balanced or dancing steps is applied to a geometrical staircase, where the nosings of the winders are so placed as not to converge on the same point, but each directed to a different point, so that the inner edge



Balanced or Dancing Steps.

of tread is wider than it otherwise would be, and the steps are thus intermediate in shape between flyers and winders. This allows of a better curve being given to the inclination of the handrail. In the sketch, the first four and the last three steps are ordinary parallel flyers, and the remainder are "balanced" or "dance," as described.

Finding Circular Curve when Centre is Inaccessible.—Three points on the circumference of a circle being known, and the centre being inaccessible, the curve is drawn by the following method. If it is for workshop use only that the curve is wanted, cut a triangular template (Fig. 1), two of whose sides touch the outer points A C and meet on the inner point B. Then pins being inserted at A and C, and a pencil or scriber at B, the template may be shifted round to describe the curve. If it is for work such as railway curves, let A B C (Fig. 2)

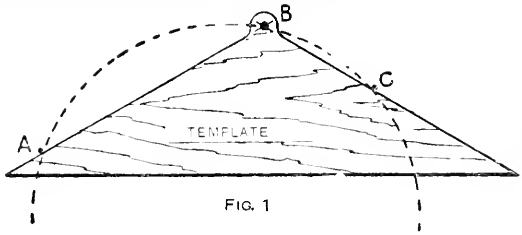
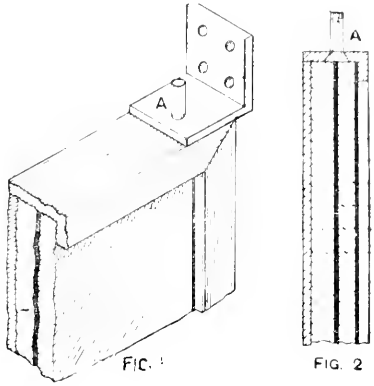


FIG. 1

Finding Circular Curve when Centre is Inaccessible.

be the three given points. Measure the lengths A B, B C, and the angle A B C; then to find radius B F, we have first $Bed + Bde = 180° - dBe$. $L \tan. \frac{1}{2}(Bed - Bde) = \log(\frac{1}{2}AB - \frac{1}{2}BC) - \log.(\frac{1}{2}AB + \frac{1}{2}BC) + L \cot. \frac{dBe}{2}$; whence by reference to mathematical tables $(Bed - Bde)$ is obtained, and then $Bde = \frac{(Bed + Bde) - (Bed - Bde)}{2}$ and $BeD = 180 - (Bde + dBe)$. Then $de = (\frac{1}{2}AB)\frac{\sin dBe}{\sin. Bed}$. $\therefore \log. de = \log.(\frac{1}{2}AB) + L \sin. dBe - L \sin. Bed$. From this $edf = 90 - Bde$, and $def = 90 - Bed$; $dfe = 180 - edf - def$; $\therefore df = de\frac{\sin. def}{\sin. dfe}$; $\therefore \log. df = \log. de + L \sin. def - L \sin. dfe$. But $Bdf = Bde + edf = 90$; $\therefore \sqrt{(\frac{1}{2}AB)^2 + (df)^2} =$ radius Bf. Now $gd : dB :: dB : dh$, or $dh = \frac{(dB)^2}{gd}$, and $2(fh) - dh = 2(Bf) - dh = dg$. If more points are required, say point i, join Ag; then $Ag = \sqrt{(Ad)^2 + (gd)^2}$, $gf = Bf$, $jf = \sqrt{(gf)^2 - \left(\frac{Ag}{2}\right)^2}$, and $\therefore ji = Bf - jf$. Other points can be found in the same way.

Tell-tale Mirror.—Instructions on making a "tell-tale" mirror are here given. Get a piece of $\frac{1}{4}$-in. by $\frac{3}{8}$-in. angle zinc for the frame, mitre together to size, 8 in. by 6 in. or 10 in. by 7 in., and solder the angles. Take the thread off two 1-in. No. 8 brass screws, to form the pins A. Drill a hole in the top and in the bottom of the frame $\frac{1}{4}$ in. from the edge, and countersink these holes on the inside to receive the heads of the screws.



Tell-tale Mirror.

Fix the latter with solder. Now cut in the piece of silver plate, and bed it in the frame with red-lead putty, making the joint watertight. Place over the back of this a piece of two-ply Willesden paper and a piece of deal board. Cut in between the frame a piece of zinc, and solder round the joint, making all level. Paint the frame black. To fix it on the window-frame, get two small brass angle brackets and drill holes in them to receive the pins on the frame, and fix as shown. Any angle required can be obtained, but it must be tested when fixing. Fig. 1 is an elevation, and Fig. 2 a section of the mirror.

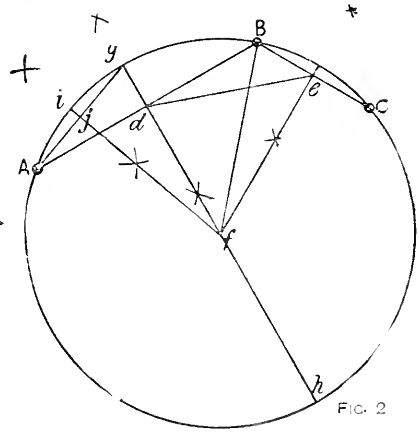


FIG. 2

Repairing Cheap Brooches.—For soldering catches and joints to cheap metal brooches that have been silver-plated or gilt, ordinary tinman's solder is used. Both catches and joints can be cheaply purchased, hard-soldered on to small plates, square, oval, or crescent shaped, to suit all kinds of brooches. Take one of these and hold it with an old pair of soldering tweezers in the flame of a spirit lamp, and give it a coating of solder on its under side. First wet it with the flux (hydrochloric acid killed with zinc, as used by a tinman), and then place a small portion of solder on it, and hold it in the flame until it flows all over the plate. It can be assisted to flow evenly by a copper wire, which is also useful to apply the acid flux. Having "tinned" the catch, clean (by scraping bright) the brooch, and place the catch in position. Direct a gentle blowpipe flame to it until it is seen to settle down and the solder flows. Then wash it immediately in warm water to remove the acid and dry in sawdust, kept in a warm place. Use as little solder as possible, and only clean the brooch where the solder is required to run. Attention to these points will ensure a neat job.

How to Make a Cheap Drilling Machine.—Fig. 1 is an elevation of a drilling machine complete. The two wrought-iron uprights A should be 1¼ in. wide, like the rest of the framework. Bend them first, care being taken to get the feet at right angles, and then cut them to length. Mark off the holes, two $\frac{7}{16}$ in. in diameter for $\frac{3}{8}$-in. bolts for the cross-bars. In one upright an extra hole must be drilled $\frac{5}{8}$ in. in diameter to take the hand-wheel shaft. This should be about midway between the $\frac{7}{16}$-in. holes, though the exact position depends on the diameter of the bevel wheels. Drill two $\frac{7}{16}$-in. holes in each foot for the holding-down bolts. The cross-bars B and C have $\frac{5}{8}$-in. holes through the centre to take the spindle F. The key-way in the latter can be cut by a $\frac{1}{8}$-in. cross-cut chisel, and afterwards cleaned out by a small square file. Next obtain a pair of bevel wheels of the same pitch, one wheel, if possible, having twice the teeth in the other. The wheels should be drilled $\frac{5}{8}$ in., the key-way in the small wheel on the vertical spindle being parallel, that in the wheel for hand-wheel shaft E being slightly taper depthways. One end of the horizontal shaft must have a $\frac{3}{16}$-in. key-way, and the wheel should be knocked on and then keyed up by a small key, preferably with a head. At the other end, the hand-wheel, from 8 in. to 10 in. in diameter, is attached either by a screw or by a square on the shaft. The wheel on the spindle F must work easily when a small parallel key is placed in the slot. The frame being bolted up, make the upright stay D so that it will just go between the two cross-bars; drill a $\frac{7}{16}$-in. hole at each end, and put the stay in position. Now with the spindle in position, with the wheel on as in Fig. 1, and with the other wheel in gear but off the shaft E, the $\frac{5}{8}$-in. holes in D and A can be marked off, and also the holes in the cross-bars B and C. For the feed gear, a piece of brass or wrought iron may be cut to shape (Fig. 2), and two $\frac{7}{16}$-in. holes and one $\frac{5}{8}$-in. hole should be drilled through it, the $\frac{5}{8}$-in. hole being cut out afterwards. Round the spindle is coiled some brass wire, coils also being wound round the two studs which are fastened to the top cross-bar by $\frac{3}{8}$-in. nuts. The two studs are screwed throughout the lengths. The feed is put on by a wing-nut on the centre stud, the springs bringing the spindle back when the wing-nut is released. A coat of black enamel over the fixtures will greatly improve the appearance.

Determining the Lengths of Pendulum Rods.—When it is required to ascertain the length of pendulum for a clock, first calculate the number of beats per minute that the pendulum is required to make. To do this, multiply together the number of teeth in the centre wheel (that carries the minute hand), the third wheel, and the 'scape wheel. Also multiply together the number of leaves in the third-wheel pinion and the 'scape-wheel pinion. Divide the product of the wheels by the product of the pinions and multiply the result by 2. This gives the number of beats per hour. Divide it by 60, and this will give the number per minute. The length of a pendulum to beat 60 per minute (the seconds pendulum) may for convenience be taken as 40 in. The length of a pendulum to beat any other number can be found from it by simple proportion, remembering that the length will be inversely as the square of the number of vibrations. Thus, for a pendulum to beat 100 per minute: as $100^2 : 60^2 :: 40$ in. to 14·4 in.

Setting Out Heavy Waggon Wheels.—In setting out the hind wheels of a heavy waggon to run in line with the front ones, the height and dish of the wheels must be known. To enable these to be worked out, a sectional elevation is given of a 4-ft. 6-in. wheel with 1¼-in. dish, the dotted lines A A being the tyre, and also showing the pitch out of the wheel, which is more or less according to the dish. To work to the wheels, put up a drawing of the hind wheel, mark in the bottom spoke B, and square up from the ground line. At C mark off the dish of the wheel; from the face of spoke at D intersect the mark at C, making the outer line A, which gives the correct position of the wheel. From the centre of the stock at the back E draw the vertical line F; from the same point draw the pitch line G, which is parallel to A. At H mark in the height of half of the front wheel, given in the sketch as 1 ft. 9½ in. Measure the distance at H from the vertical line F to the pitch line G; this will show how much less the front wheel cuts under in its height than the back one. Double this distance is the extra length required in the hind axle bed compared to the front one.

Removing Dent from Brass Kettle.—To remove a dent from a brass kettle, insert the head of a small round-faced hammer through the cover hole, and knock the dent outwards; then hold the face of the hammer up against the bruised part, and go over the outside lightly with a flat-faced bright hammer until the metal is quite smooth.

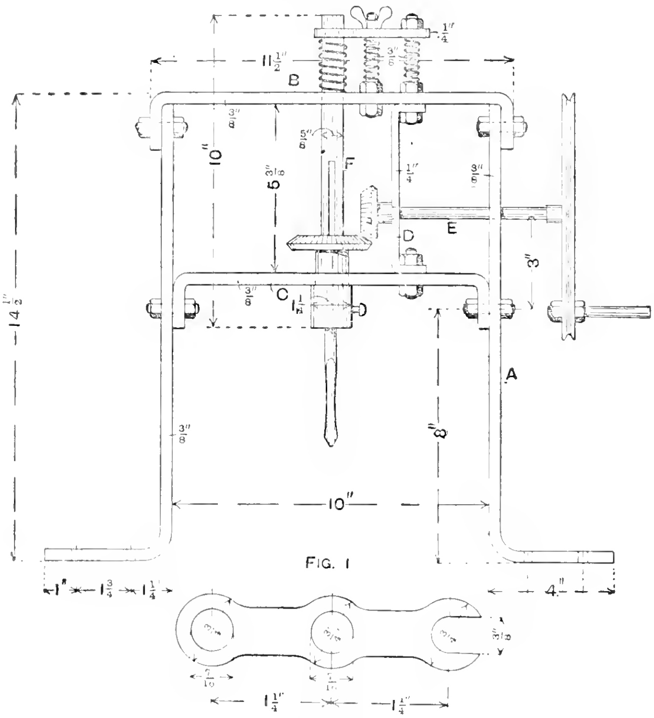
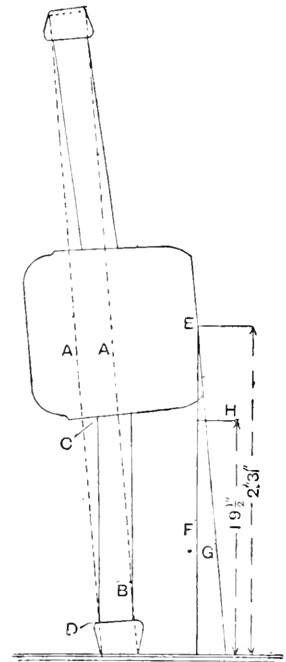


FIG. 1

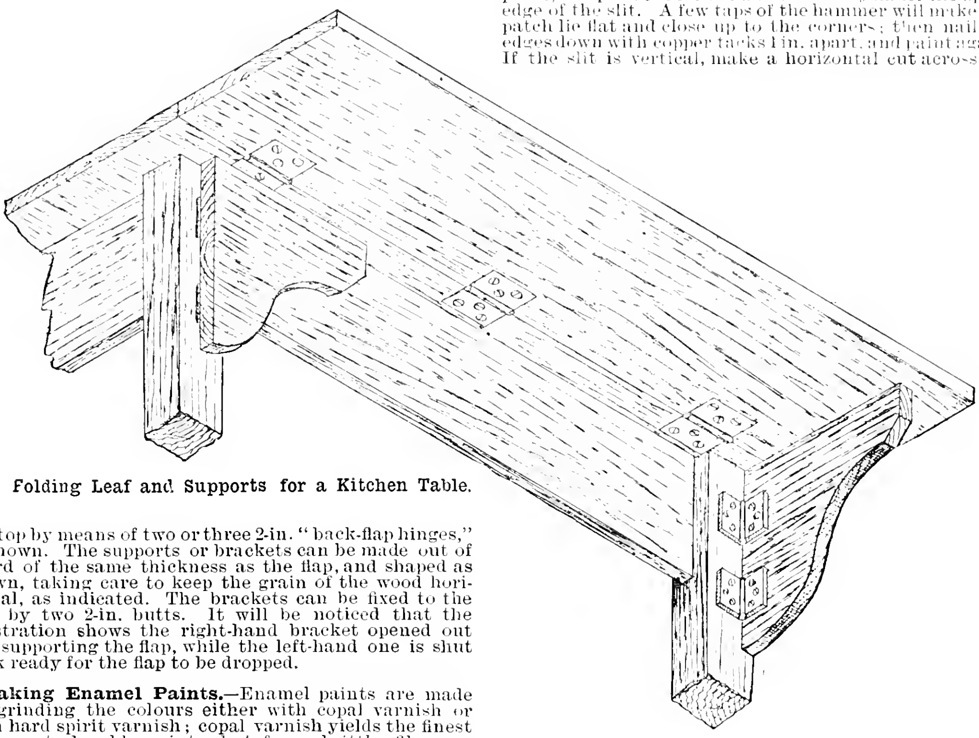
FIG. 2

How to Make a Cheap Drilling Machine.



Setting Out Heavy Waggon Wheels.

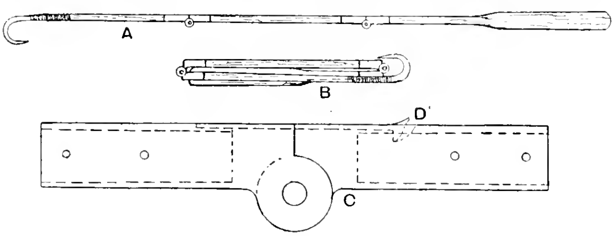
Folding Leaf and Supports for a Kitchen Table.—The sketch explains how to fix a folding leaf 9 in. wide to an ordinary kitchen table and how to hinge the supports to the table top. Use the best white deal or pine both for the flap and supports. The flap should be attached to the top by means of two or three 2-in. "back-flap hinges," as shown. The supports or brackets can be made out of board of the same thickness as the flap, and shaped as shown, taking care to keep the grain of the wood horizontal, as indicated. The brackets can be fixed to the legs by two 2-in. butts. It will be noticed that the illustration shows the right-hand bracket opened out and supporting the flap, while the left-hand one is shut back ready for the flap to be dropped.



Folding Leaf and Supports for a Kitchen Table.

Making Enamel Paints.—Enamel paints are made by grinding the colours either with copal varnish or with hard spirit varnish; copal varnish yields the finest and most durable paints, but for a brittle film use spirit varnish. The dry colours are, perhaps, the best for grinding with the varnish, but the grinding must be very thorough.

Folding Gaff for Salmon Fishing.—A pocket telescopic gaff for salmon fishing is shown by the accompanying sketches, in which A is the gaff extended for use, B folded up, and C one of the spring joints. The joints are made similarly to the joint of a 2-ft. rule, with the exception that a spring D is provided to hold them when open and that sockets are on each end into which the wooden portions of the handle are fitted.



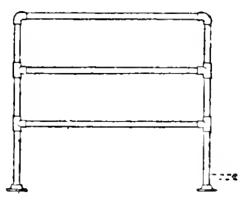
Folding Gaff for Salmon Fishing.

The handle should be of lancewood or greenheart, the top sockets $\frac{3}{8}$ in. diameter, and those of the lower joint $\frac{7}{16}$ in. diameter.

Making Oiled Fabrics.—Lay the material—silk or cambric—upon a board, and coat it on both sides with boiled linseed oil, then hang up to dry. Large balloons are made of oiled cambric or cotton; the joints are made gas-proof with a coating of linseed oil. Allow the joints to overlap, stitch them on both sides of the overlapping part, and apply a coat of boiled linseed oil over the stitches.

Repairing Cut in Canvas Roof.—On a close-boarded roof, if the slit is horizontal, cut a piece of canvas $\frac{1}{8}$ in. wider than the slit (say $3\frac{1}{8}$ in. square), then push the point of a trowel or something similar into the slit and upwards to free the canvas from the boards for a few inches. Give both patch and torn part a coat of thick paint, and push the former about halfway under the upper edge of the slit. A few taps of the hammer will make the patch lie flat and close up to the corners; then nail the edges down with copper tacks 1 in. apart, and paint again. If the slit is vertical, make a horizontal cut across the top 3 in. long, forming a T. Paint and tack the vertical portion and proceed as described above, making the patch long enough to cover the lower end of the slit.

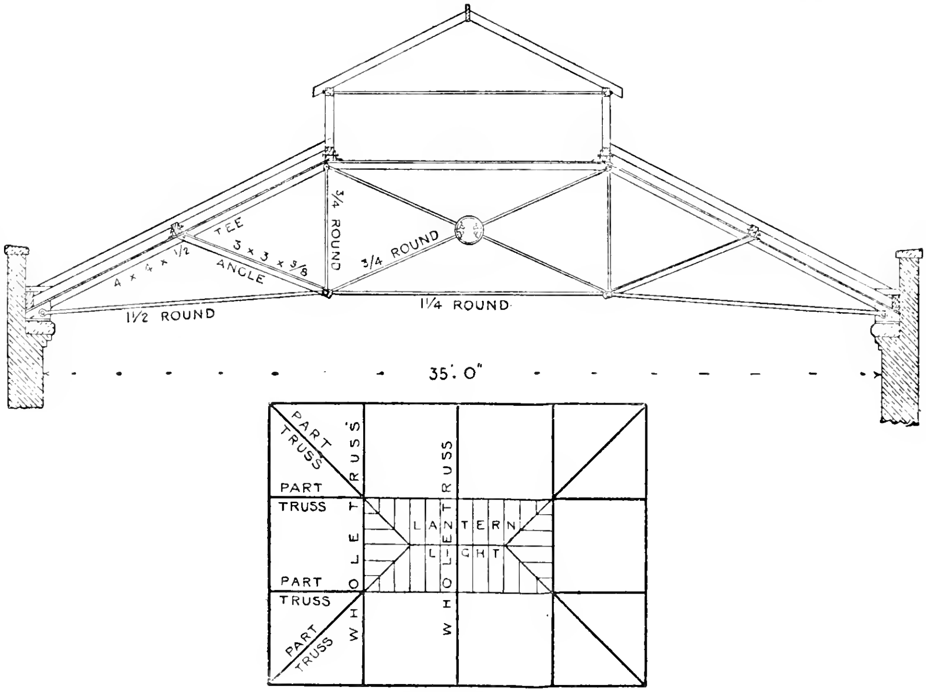
Hot-water Towel Airer.—The accompanying sketch shows a hot-water towel airer with three rails, but of course the number of rails, the dimensions, and the design of the airer can be varied as desired. The airer is made of 1-in. iron tube and fittings, and any threads that are exposed must be soldered up solid before painting. Some fill up the exposed threads with putty, but, needless to say, this often proves a failure. It will be necessary for some of the tubes to be connectors, and the backnuts are made by cutting short collars from a socket and cleaning them off neatly. The ordinary wrought fittings do not look nearly so well as the globe-shaped malleable fittings (elbows and tees). Connect the airer to a flow pipe wholly, neither connection being put to a return pipe. The connecting pipes can be $\frac{3}{4}$-in.; even $\frac{1}{2}$-in. will do if the length is short. A stop-valve can be used if desirable. The dotted lines in the sketch indicate that connections to the rail may be made above or below the floor.



Hot-water Towel Airer.

Refining Scrap Gold.—One method is to dissolve the scrap gold in a mixture of 1 part pure nitric acid, 3 parts hydrochloric acid, and 1 part pure water made warm in a porcelain basin and placed in a good draught to carry off the poisonous fumes. Drive off excess acid by heat, dissolve the resulting red salt in pure water, and carefully decant or filter to remove silver chloride. Add a solution of protosulphate of iron until all gold is thrown down as a brown powder. Decant off all iron and copper solution. Well wash the gold several times in hot water, and dissolve to form the gilding bath, or dry and fuse with borax in a fireclay crucible. Another method is to melt scrap with twelve times its weight of pure lead on a large bone ash cupel and keep up the heat in the open air until all copper and other base metals have been oxidised. Then fuse the button of gold with two and a half times its weight of pure silver, and dissolve out all silver in warm nitric acid.

Design for Iron Roof.—The accompanying design for a steel roof truss of 35-ft. span, with lantern lights, shows elevation of one truss in the cross-section through roof, and the plan shows the arrangement of the hipped



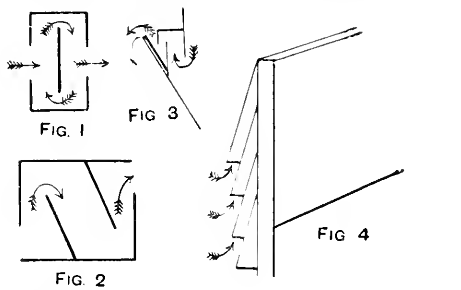
Design for Iron Roof.

ends. The truss is arranged in three bays of 11 ft. 8 in., and the trusses will be that distance apart. At each hip there will be two part trusses formed like one side of main truss to meet the main truss at end of lantern.

Making and Using Graphs for Copying Written Matter.—The ingredients (4 parts of whiting to 1 part of pure glycerine) must be thoroughly mixed. Reduce the whiting to a fine powder; mix half the required quantity with all the glycerine, and beat up thoroughly. About twelve hours later, add the remaining powdered whiting. Spread out the composition in a dish or tin. If the glycerine comes to the surface after standing a short time, sprinkle a little powdered whiting over it, roll up the mass, thoroughly knead it, and again spread it out smoothly. Repeat until the composition is firm, but not absolutely dry. The copier will be useless if the glycerine is repeatedly wiped away. For use at lengthy intervals, keep the copier well covered; and if the top is too wet for use, do not remove the moisture, but beat up the whole of the composition, and spread it out evenly again. If it is too dry, add a little glycerine. Graphs on which the original writing is transferred cannot yield a number of copies all equal in strength, as with each impression the quantity of ink on the graph decreases. Therefore, if twelve copies are required, let the first few sheets of paper rest on the transferred writing about twenty seconds; gradually increase the time of contact, letting the twelfth remain about two minutes. To obtain twenty-five copies, proceed as follows. Take the first ten or twelve impressions quickly, and directly they have been smoothed lift them over the graph. Then allow each succeeding paper to remain rather longer on the graph than the one preceding. By writing with Judson's violet dye, sixty perfectly legible copies can be obtained. Not more than thirty copies can be expected from an original written with Stephens' liquid ebony stain, and it is well to limit the number to twenty-four or twenty-five. Always write the original on thick, smooth-surfaced paper. Paper of a spongy texture must not be used. Keep a good supply of ink always in the pen, which should have a very fine point; Perry & Co.'s ladies' pens, fine points, are recommended. Firm, thin lines give best results. Put a sheet of clean paper on the graph, and pass a flat stick over it to make a perfectly smooth surface. Directly the writing loses its wet appearance, place it face downwards on the graph; be certain that every portion of the writing comes in contact with the composition, and leave it so from ten to fifteen minutes. This length of contact while transferring does not apply to gelatine graphs, into which the ink rapidly sinks, whereas in the one under discussion the ink is inclined to get to the surface. The ink will not transfer so readily if dry and hard when placed on the copier. Get ready the sheets of paper whereon the impressions are to appear; gently remove the original from the graph; take the first copy quickly, and examine it closely to discover faulty words caused by air bubbles or depressions forming on the surface of the graph. Note the exact position of the fault on the composition, proceed with the second copy, and, while the paper is on the graph, press gently on the defective parts with a knife handle or other hard, smooth substance. This will level the composition. When sufficient impressions have been obtained, wash off the writing with a wet cloth or sponge. Remove any excess of water with clean white paper. Avoid using blotting-paper and like substances for this purpose. To gain experience for taking impressions of a larger size start with something of a postcard size. Put a strip of paper at one end of the graph as a guide for placing the sheets of paper evenly over the writing. Let one edge of a sheet lie level with the guiding strip, and draw a hard wooden ruler or other smooth piece of hard wood over the top of the paper to ensure every part touching the writing with equal pressure. The writing may be in two colours, and copied simultaneously, but it is more difficult to time the length of contact necessary than when copied separately.

Preparing Fulminate of Mercury.—The following directions for preparing fulminate of mercury are taken from Bloxam's "Chemistry, Inorganic and Organic." "Dissolve 25 gr. of mercury in half a measured ounce of ordinary concentrated nitric acid (sp. gr. 1·42) in a ½-pt. beaker and cover with a dial-glass; the solution may be allowed to take place in the cold, or it may be accelerated by gentle heating. It contains mercuric nitrate, nitric acid, and nitrous acid. When all the mercury is dissolved, remove the beaker to a distance from any flame and pour into it, at arm's length, 5 dr. (measured) of alcohol (sp. gr. 0·87). Very brisk action begins, and the fulminate separates as a crystalline precipitate: dense white fumes, having the odours of nitrous ether and aldehyde, pour over the sides of the beaker; they contain mercury compounds and hydrocyanic acid also, and are very poisonous. When red fumes begin to appear abundantly, some water is poured in to stop the action (which occupies only two or three minutes), and the fulminate is collected on a filter, washed with water as long as the washings taste acid, and dried by exposure to air."

Ventilation of Photographer's Dark Room.—So much depends on the situation and surroundings that it is difficult to give particulars of a method of ventilating a photographer's dark room without seeing a sketch of the room. The following plan, however, may be tried. Cut an opening near the bottom of the door and screw over this opening on the inside a box with a partition, formed as shown in Fig. 1, and coated inside and out with a dead black, made by mixing lampblack with negative varnish. A similar opening and box may be made for the top of the door. The air will enter by the bottom ventilator and pass out by the top one. When the light outside the dark room is strong, the opening may be fitted with two partitions, set at an angle as shown in Fig. 2. If it is not convenient to cut holes in the door, the ventilator may be formed in the jamb of the door, as in Fig. 3, covering the edge at X with soft baize to ensure a light-tight join when the door is closed. Fig. 4 shows a very usual method of ventilating just below the eaves by overlapping boards.



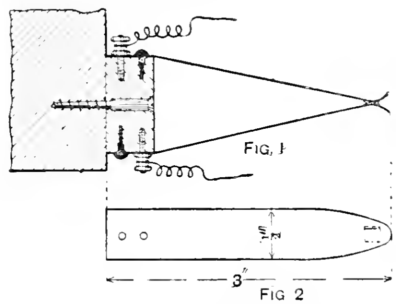
Ventilation of Photographer's Dark Room.

Fixing Fringe on Mantelboards, etc.—So that deep fringes may be made to hang straight on mantelboards, etc., before fixing the fringe, tack strips of cardboard or buckram, about 2 in. narrower than the fringe, on the edge of the mantel. For a 6-in. fringe, back up with say, a 4-in. strip of cardboard; for quick curves, etc., kerf the cardboard with a knife.

Working Pressure of Model Locomotive Boiler.—A small locomotive boiler with a barrel 5½ in. long by 2½ in. diameter has its iron plate $\frac{1}{16}$ in. thick. If the tensile strength of the material is 20 tons per square inch, and the joints are single riveted, the bursting pressure of the shell may be $\frac{2 \times \frac{1}{16} \times 20 \times 2{,}240 \times \frac{55}{100}}{2\frac{1}{2}}$ = 1,332 lb. per square inch; so that as far as the shell is concerned the working pressure may be 200 lb. per square inch. If copper were used for the barrel, the working pressure with the same factor of safety might be 120 lb. per square inch.

Polishing Stalactites, etc.—In polishing stalactites and similar stones no false gloss is put on, the surface of the stalactite merely being made smooth. Having decided which part of the stone to polish (it should be the one which will exhibit the formation of the stone), all irregularities are rubbed out on an ordinary flagstone, using silver sand and plenty of water; and when all holes, etc., are well rubbed out, wash and dry the stone. It can then be seen whether the surface is anything like smooth; if not, continue the rubbing. The better this part of the work is done, the easier will be the next steps. When no more can be done with the silver sand, rub the specimen with a piece of second grit-stone, to remove all scratches made by the sand, and then rub with a piece of snakestone or water-of-Ayr stone. The surface should now be perfectly smooth, but minus a gloss or brightness. To impart this, rub it well with a damp piece of an old stocking on which has been sprinkled a few grains of oxalic acid. The surface of the specimen should now have a dull face; to finish, a little putty-powder and a very little salt of sorrel are used in the same way as the acid. Marble polishers use polishing-felt instead of the old stocking. Marble may be polished in the same way, but some varieties will require spirit of salt to be used with the putty-powder instead of the salt of sorrel.

Shop-door Electric Alarm.—The shop-door alarm for electric bells here described rings the bell during the whole time the door is open. There are two separate portions the "contact springs" and the "separator" or "insulator." The two springs are screwed, as shown by Fig. 1, to a block of hardwood about 1 in. by 1 in. by ½ in., well soaked in paraffin wax. The springs may be made from an old clock spring straightened out, one end of each being filed as shown in Fig. 2, and about ¼ in. from this end a piece of platinum foil may be soldered or riveted. The springs should be bent as in Fig. 1, so that the platinum points will be pressed well together. A binding screw and an ordinary brass screw, ½ in. or $\frac{5}{8}$ in. long, should be sufficient for each spring. The "separator" is a wedge-shaped piece of hardwood, with an extension for screwing to the upper part of the door. It should be well soaked in melted paraffin wax. The contact-spring block is screwed to the lower edge of the door-frame, just above the door; and the insulator is fixed to the door, near the top, so that when the door is closed the springs are wedged apart. The alarm is next connected up to the bell and battery, one wire from a binding screw of the bell to a binding screw of the alarm, another connecting the second terminal of the alarm and one pole of the battery, and a third lead joining the free terminals of bell and battery. By the interposition of a switch in the circuit, the door can be opened by the occupants of the house or shop without the bell ringing.



Shop-door Electric Alarm.

Toughening Potters' and Modellers' Clay.—Newly dug clay is generally wanting in tenacity, and ware made from it is much more liable to crack than if the clay had been "weathered." Weathering, or exposure to the weather, will toughen the clay. The clay, when dug, is laid in heaps and occasionally turned over. The water and oxygen of the atmosphere and the influence of frost disintegrate, wash, and purify it, thus greatly improving its quality. Clay is also toughened by being well worked or kneaded. For modelling purposes there is nothing like old clay—that is, clay that has been repeatedly used; and consequently, when a mould has been made from a clay model, the clay is thrown back into the bin, becoming tougher and more ductile by this continual usage. Clay may also be toughened as follows: Spread out a small lump of it on a board. Mix together a tablespoonful of sulphuric acid and linseed oil, and spot this here and there over the exposed surface. Roll up the clay and well work it together.

Dry Process of Cleaning Skins.—The skins may be soaked in petroleum ether in a closed tank or pan for two or three days, removed, wrung out, dried, brushed, and combed; or they may be well brushed all over with a mixture of bran and benzoline, and, after drying, brushed and combed. Another method is to brush the skins with a solution of olive-oil soap in methylated spirit, followed by sponging with clean methylated spirit.

Hardening and Softening Copper.—The difference between hard-rolled and special soft copper is caused by the methods of annealing. Hard-rolled copper can be rendered soft and ductile simply by placing it over a fire or stove until well heated, and then gradually allowing it to cool. Copper may be hardened by well heating and then plunging it for a moment in cold water, afterwards allowing it to steam dry. If kept submerged until cold the metal will prove exceedingly brittle. In repoussé work soft copper will crack whenever the tool is applied too forcibly; these cracks may be repaired by soldering from the back.

Building a Dutch Barn.—Fig. 1 is an end elevation, and Fig. 2 a little more than one-fourth of the side elevation, of a Dutch barn that is 40 ft. long, 18 ft. wide, and 16 ft. to eaves. Fig. 3 shows the form and construction of the trusses. It will be noticed that purlins, not rafters, are used, so that the boarding can be fixed running down, as shown. The wet can be better kept out by weathering the boards, as shown at Fig. 4. Oak will be best for the posts, which should go into the ground about 4 ft. or 5 ft., and be well rammed in. Deal will probably be good enough for all the other parts. The boarding (1 in. thick) to the ends and sides may be grooved and tongued, or lapped similar to the roof. To keep the structure rigid, it must be braced with 4-in. by 3-in. braces, as indicated by the dotted lines on the boarding at Figs. 1 and 2.

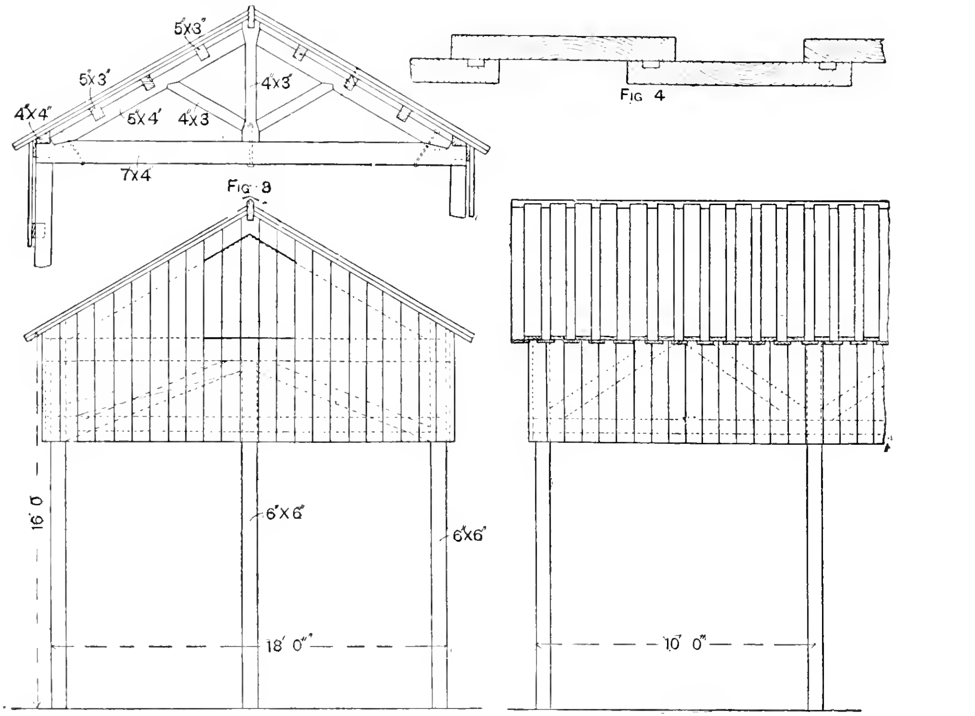


Fig 1
Fig 2

Design for a Dutch Barn.

Staining in Marqueterie.—Red and blue lines as seen on old Sheraton inlaid work are gained by inlaying narrow stringing, stained before insertion. It is not worth the expense to stain them with acids if only a small quantity is required, especially as good results can be obtained by the use of aniline dyes, which should be mixed in hot vinegar. If the work is imitation stained marqueterie, use aniline dyes dissolved in spirits, with the addition of at least a quarter of its bulk of polish or spirit varnish.

Distillation of Tar.—When coal-tar is heated in the still, there is a large amount of frothing due to the distillation of the ammoniacal liquor; it is therefore necessary to slake the fire to prevent this; if any tar boils over, pour water on the still head. After a time the mass "bumps" vigorously and then "rattles," owing to the escape of the water. As the water distils over, the first runnings pass along with it and float on the surface of the liquid. After all the water has distilled over, the "break" occurs, *i.e.* distillation slackens until the temperature rises and the distillation proceeds again. The different fractions are told by the smell, by gravity, and by the temperature in the still at the time, a thermometer being fixed in the still for this purpose. The first runnings pass over below 110° C., and their specific gravities are less than 1·0. The light oil passes over from 110° to 120° C., and its gravity is about that of water = 1·0. Carbolic oil or middle oil passes over between 120° and 140° C., and its gravity is over 1·0. Creosote oil passes over between 140° and 170° C.; it is heavier than carbolic oil. Anthracene oil passes over last. The residue is pitch, which is soft or hard, according to how far the distillation has been pushed. The different fractions can be told by pouring a few drops of the oil into water; the first runnings float on the surface, the light oil will float anywhere in the water, whereas the carbolic and other oils sink; this test will tell when to change the receivers, but the temperature test is best. The first runnings and light oil are rectified by distillation with "close" or "open" steam yielding—(1) Up to 103° C, 65 to 70 per cent. benzol; (2) up to 110° C., 30 per cent. benzol; and (3) up to 130° C., a benzol none of which distils at 100 but 60 per cent. passes over at 120° C., this being usually put back with another charge; and (4) above 136° C. yields "solvent" naphtha. The 65 to 70 per cent. benzol is again rectified into two fractions called 90 per cent. benzol and 50 per cent. benzol respectively.

Cleaning Mosaic Floors.—For cleaning tile mosaic floors, use muriatic acid (spirit of salts) diluted with water (the requisite strength may be found by trial), well scrubbing the floor with an old brush, and washing off with clean water. For marble mosaic floors, use a bleach consisting of, say, 7 lb. of American potash dissolved in a pailful of water, and made into a paste by adding whiting, or, better still, newly slaked lime. Apply this like whitewash with an old brush to the floor. Let it remain on for a day or two, and then wash off with clean water. Repeat the application until the stains are removed. The hands must be protected when using the bleach, as the potash is so caustic as to be dangerous to fingers and nails. If any of the liquid gets on the hands, they should be at once well washed in water containing a few drops of vinegar or acid to neutralise the alkali.

How to Make Cheap Paste.—For a cheap paste that will not turn sour or go bad, mix together 1 lb. of common flour, ¼ lb. of alum, and 1 qt. of water to make a smooth cream; boil 3 qt. of water in a pan, and while boiling add the other ingredients in a thin stream, stirring all the time. Continue boiling for a few minutes, then remove the pan from the fire. Oil of cloves may be added as a preservative.

How to Make a Mailcart.—Figs. 1 and 2 show a useful mailcart. To make this, first get out the shafts from a piece of stuff, 4 ft. 4 in. by 8 in. by 1¾ in., preferably of ash (Fig. 3). Saw with the grain of the wood, following the sweep as nearly as possible. The finished shafts are 4 ft. 4 in. long, 1½ in. deep on the straight part, and 1¾ in. thick at the centre bolt hole, and tapering in thickness to ⅞ in. at the front ends and 1 in. at the handles, which are shaved up to fancy. The shafts are bolted on so that, by taking out the centre bolt, the handles can be raised to a height more convenient for an adult, the bolt fastening through the next rail above. For one side, seven pieces are required. The two uprights are 26 in. long, ¾ in. thick, and about 1¾ in. wide, with edges bevelled as shown, and five rails are 1½ in. wide and bare ½ in. thick. The top rail is 26 in. and bottom rail 31 in. long. The rails are fixed inside the uprights with ¼-in. bolts, and the two sides of the cart are held together by the seats (with back) and the steps, which are 4 in. wide and ½ in. thick. The seat boards are 9 in. wide and full ⅜ in. thick. For the seat back, the two upright pieces, seen endways in Fig. 2, are 14 in. long, 1¼ in. wide, and full ½ in. thick, and the two rails which connect them together are oval in section, the top one being 2½ in. and the lower one 1¾ in. wide, and both about ½ in. thick at the centre. When together, the cart, outside the uprights, is 19 in. wide at top and 12½ in. at bottom. A pair of 22-in. rubber-tyred wheels with axle will, of course, have to be purchased. The springs, which fasten the wheels and axle to the body, and which raise the steps 5 in. from the ground, can be made of 1-in. iron about ⅛ in. thick, the ends being fixed with small coach screws either to blocks fixed inside the lower rails, or under the seat boards as seen in Fig. 2. In finishing, round off all the corners and edges with sandpaper; black enamel the ironwork, and give the wood two or three coats of good oak varnish. Almost any kind of wood might be used, walnut and birch being the most serviceable and deal the cheapest.

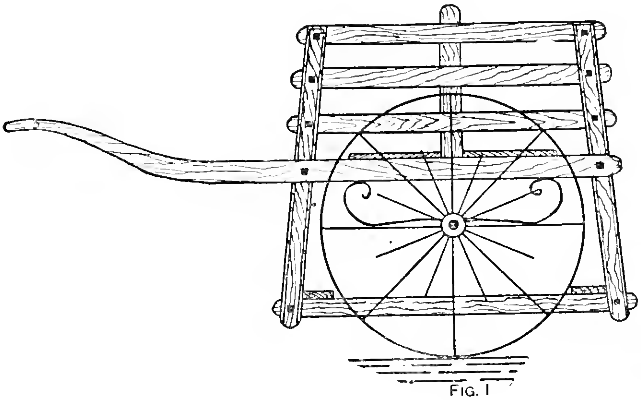


FIG. 1

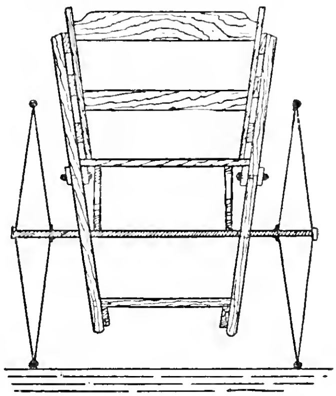


FIG. 2

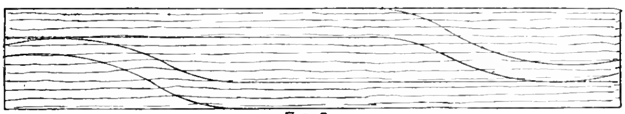


FIG. 3

How to Make a Mailcart.

Black Polish for Shop Fittings, etc.—The method of producing the glossy black polish generally seen on jewellers' shop cases and on the frames of mirrors is as follows. The parts to be polished must be cleaned up with fine glasspaper, all unevennesses, such as marks of the plane-iron or other tool, being carefully removed, as no polish shows defects more clearly than black, especially on flat surfaces. The ingredients required for polishing are French stain, linseed oil, plaster-of-Paris, spirit black, button polish, and methylated spirit. The parts to be polished should be covered with the French stain, which, when dry, is a blue black, and then with plaster-of-Paris mixed with water to the consistency of thick cream. When nearly dry, rub off as much as possible, leaving the surface clean, the grain only being filled with the paste. Linseed oil is next applied with a piece of old rag; ¼ oz. of spirit black is then dissolved in 1 gill of button polish, and applied in the usual way with a cotton-wool rubber. A little linseed oil must be used on the rubber to make it work freely. When a good body has been obtained, any parts which are ropy may be levelled with a piece of old, fine glasspaper and a little linseed oil. The wool rubber is then covered with a piece of old linen and the final coat is given, using as little oil as possible on the rubber. When a satisfactory surface has been obtained, the linseed oil remaining in the polish must be killed, otherwise the work will have a dull appearance. Make a new rubber with cotton-wool and a piece of clean linen, and damp the rubber slightly with methylated spirit, and use the rubber as when giving the final coat. If too much spirit is used, all the polish will be taken off. If the above instructions have been carefully carried out, a highly glossy finish will be obtained.

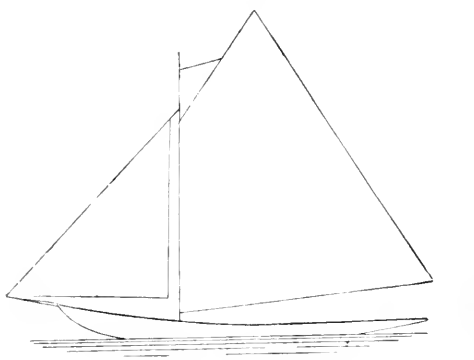
Flat Colours Flashing or Patchy.—The cause of an interior wall surface finished in flat colours drying bright in patches may be that the under colour was not quite dry in places; or perhaps the flatting was not evenly distributed over the work; or the colour may have commenced to set on one lap before there was time to follow on; or, yet again, the brushes may not have had all the oil colour thoroughly washed out before being put into the flatting colour. To ensure perfect work, the under coats should be brought up well, as the flatting is only for a final dead effect. Should the walls be of large area, at least three men should be employed—two to lay on the colour without intermission, and one to follow immediately behind with the stippler, doing the work without a break until the wall is finished. The woodwork, being of smaller area, may or may not be stippled. The room should be closed during the operation, but opened afterwards, and the air allowed to enter freely until the work is dry.

Wax and Varnish for Fish Hook Bindings.—To make a material for whipping fish hooks, melt over a slow fire in an earthenware pot for ten minutes ¼ lb. of best white resin and ½ oz. of white wax; add ½ oz. of tallow or fresh lard, and simmer gently for a quarter of an hour. Pour the mixture into a basin of water, and work between the fingers till white and pliable. After tying, the whippings should be varnished with the following:—Crush a little sealing wax of the desired colour and dissolve in methylated spirit; or, if transparency is desired, use shellac instead of the wax. Apply with a camel-hair brush; give two or three thin coats, taking care to allow the binding to dry well between each coat.

Liquid Gold for Gilding without Battery.—Gold is converted from a solid to a liquid by dissolving the metal in a mixture of nitric and hydrochloric acids. This liquid will deposit metallic gold on baser metals, and it forms the basis of nearly all gilding liquids. Added to a solution of caustic potash, carbonate of potash, and cyanide of potassium, it forms a simple gilding solution, used at a boiling temperature. Deprived of its excess acid by heat, then dissolved in distilled water and mixed with a solution of carbonate of potash at a boiling temperature, it also furnishes a simple gilding liquid.

Repairing Pewter Articles.—Pewter vessels, etc., are repaired by soldering. Pewterers' solder is composed of 2 parts of bismuth, 1 part of lead, and 1 part of tin. When making the alloy, melt the lead first, then add the tin and bismuth; sprinkle a little resin on the surface of the molten alloy to prevent oxidation, well stir it, and then pour the metal into an iron mould. When using the alloy, first well clean the article where it is to be soldered by scraping with a sharp knife, then rub a little tallow over the cleansed part. Melt a small knob of solder from the stick; place the knob on the part to be soldered, and, with a fine jet from a blowpipe, blow gently upon the solder until it flows over the part to be repaired and adheres to the pewter; smooth the edges of the patch of solder with a smooth file, and finish off with a burnisher.

Sail Plan for Model Yacht.—For a model yacht of the fin-keel type 3 ft. long, 8¼ in. beam, and 11½ in. deep with fin, the sail plan here given will probably be suitable if the bulb on the fin is in the usual position. The boat will require about 7 lb. of lead.



Sail Plan for Model Yacht.

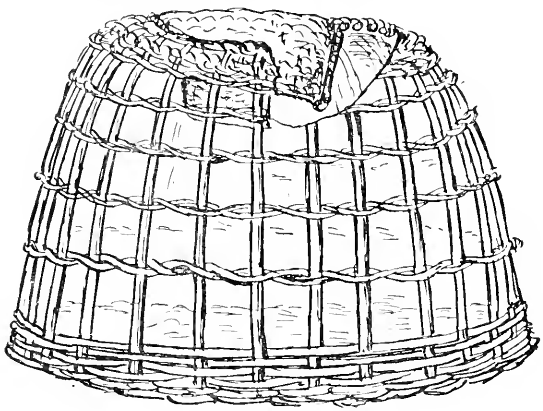
Drawing a Pivot Hole in a Watch.—A pivot hole is drawn in a Geneva or other kind of watch by pressing a pivot broach against one side of the pivot hole only and revolving it; this is continued until the original round pivot hole is drawn oval. Then broach it out round and bush it with a watch "bouchon," and open it out to fit the pivot once more.

Renovating Old Oak Furniture.—The following instructions are on renovating an old oak bureau or similar piece of furniture. Place ½ pt. each of methylated spirit and turps in a stone jar, and heat in a saucepan of water to blood heat. Be careful that it does not take fire. Brush the hot solution over the bureau and rub off the softened varnish with coarse rag or canvas; repeat as often as required till a perfectly clean surface is gained. To fetch out the figure of the wood, wipe all over with raw linseed oil, rub down with fine glasspaper over the oil, then wipe off all dust. The work should now present a clean, level surface, suited for finally finishing by wax polishing, French polishing, or spirit varnishing.

Painting Stone Mantelpiece to Represent Marble.—These instructions are on painting two stone mantelpieces—one in imitation black marble, with gold lines, the other to represent white marble. If the mantelpieces are porous, coat with whiting and size, and thoroughly rub down before painting. If the mantel is to be finished black and gold, it should first be prepared black. Place on a pallet a little venetian red, ochre, white, and a little lead colour. First dip the pencil or a feather into the red, and imitate a few veins by scumbling the colour on to the mantel. Follow with the ochre, occasionally adding a little white to produce variety. Very fine lines should break away from the larger ones in imitation of the real stone, which should be studied to get a good effect. Finally, the spaces between the veining should be filled in with the lead colour, using a fitch for the purpose. When dry, give two coats of varnish. White marble must be done on a white ground whilst the paint is still wet. Rub up on the pallet a little blue-black with a little white, and lay in the veins as described for the black, but the whole must be softened in with a hog-hair softener while wet. Use all the colours rather thin.

Foundation for Chimney-stack.—The concrete for the base of an 80-ft. chimney-stack should be formed of good Portland cement and ballast, or stone chippings, in proportion by measure of 1 cement to 2 sand or fine chippings, and 5 large gravel or broken stone. A block of concrete, 13 ft. square by 5 ft. deep, would require about 130 bushels of Portland cement. The materials for the concrete should be mixed dry, about half a cubic yard at a time, and then thoroughly re-mixed while being watered through a rose, so as to moisten the whole without washing out any cement. It should then be wheeled to the trench and tipped in, spread level, and gently beaten on top to consolidate it. Often the building commences directly the concrete is all laid, but it will be better to leave it for a week to harden. Any part projecting above ground should be supported by boards until well set.

Crab and Lobster Pot.—Herewith is an illustration of a crab and lobster pot, which consists of an openwork wicker basket, about 30 in. in diameter by 20 in. high, with a strong bottom. At the top is a funnel 6 in. deep by 8 in. diameter on the outside, tapering to 6 in. on the inside. Stones are lashed to the bottom, inside, to sink the trap, and a strong line with cork floats, fixed at intervals to denote the position, is attached to the side.



Crab and Lobster Pot.

Making Rugs from Raw Hides.—The treatment of skins with alum and salt, or "tawing," as it is called, is more often resorted to than tanning for the dressing of skins for making rugs. The skin should be thrown across a bench, and the adhering flesh and fatty tissue either cut or scraped away with a sharp knife. The flesh side of the hide may next be treated for a week or two with a bran mash, which, by a process of fermentation, softens the inner integument, and allows it to be removed. This may prove useful in softening the inner membrane of tough skins, and afterwards allows it to be separated with the knife. The object of this treatment is to remove all material that may afterwards tend to putrefy. Next treat the skin with a tepid bath of 7½ lb. of alum and · lb. of common salt to 3 gal. of water. A portion of this solution should be made slightly warm, and then well rubbed into the skin with a brush. The skin should be allowed to remain damp for a few days, then pinned down tightly stretched on a board, and placed in the sunlight to dry. For tanning skins, it matters very little what proportions of material are used. Half fill a copper or earthenware vessel with oak bark chips, and fill up with boiling water; keep simmering for a few hours, then strain. Place the skin in the infusion as soon as it becomes tepid, and allow it to remain for at least three weeks; remove, shake well, peg on a board, and allow to dry. The length of time required in tanning a skin depends upon its thickness and upon the strength of the solution. With a strong solution the time is lessened; but it is not advisable to use a strong infusion at first, or the skin may be only superficially tanned. Treating as has been described, three weeks is a fair time to give it.

Castings for Lead Toys.—For casting toys in lead, the moulds are made of cast iron. The metal used for these toys is an alloy composed of bismuth 8 parts, lead 5 parts, and tin 3 parts: this melts at a low temperature (202° F.) and expands on cooling, and so fills all the fine lines of the mould, giving a sharp, clean casting. The mould should be brushed over with blacklead and warmed before it is used.

Potters' Clay for China and Porcelain.—If the objects to be thrown on the wheel are of ordinary earthenware, the clay may be "ball" clay. This clay is found in Dorsetshire, and is used in its natural state without further preparation. If the articles are of fine china or porcelain, the clay is specially prepared. Kaolin, or china clay, is found in Cornwall, and is produced by the decomposition of a variety of granite called pegmatite. In the manufacture of porcelain, this clay may be mixed with calcined bones, flint, etc. These materials are weighed and measured, and placed in large vats filled with water, in which they are thoroughly stirred up and mixed together. The mixture is then run into troughs and passed through fine sieves of lawn, and afterwards left till the superfluous moisture has evaporated. It is then "wedged," or repeatedly cut up, and it is then ready for the thrower.

Setting a Lever Watch in Beat.—The easiest way to tell whether a lever watch is in beat is to wedge the fourth wheel to take off the power, and allow the balance to come to rest in its natural position. The lever should then be exactly in the centre, between the banking pins or studs. To set a Geneva lever in beat, turn the hairspring collet round upon the balance staff by inserting the thin blade of a watch oiler or something similar in the slit in the collet. Being out of beat would not cause the watch to lose, but it might be caused by the hairspring having too much play between the curb pins. If it cannot be traced to this cause, the hairspring must be shortened by re-pinning in the stud, and the watch again set in beat.

Bending Copper Pipes.—The following is one of the best methods of bending copper pipes of 1-in. and ½-in. diameter. First carefully anneal the pipe by heating it to a cherry-red. When the pipe is cold, tie brown paper round and over one end, insert this end in sand, and pour molten lead into the tube until it is quite full. If a firmly fixed bench is available, cut a hole in this a little larger than the tube, and chamfer the sharp edge off around the hole. Remove the paper at the end of the tube, and pass the tube through the hole in the bench to where the bend is to occur. Grasp firmly the top end of the tube, and pull it over against the rounded shoulder at the top of the hole; pass the tube a little farther through the hole and again bend, and repeat this operation until the desired curve is imparted to the tube. Should there be any bruises in the throat of the bend, work these out with a round-faced hammer, and then re-heat the tube until the lead runs out and leaves the interior clear.

Plotting a Survey.—In explaining the method of plotting a survey by the use of co-ordinates, it may be stated that in the survey of a piece of land a system of triangulation must be laid out, the junctions of the lines to be chained being marked by station poles. The lines should approximate to the boundaries, and such additional lines taken as will form up the boundaries into a series of triangles. Each triangle is theoretically perfect when the length of the three sides is known, but practically it is necessary to cause another line to cross the triangle to check the measurements. The triangles are plotted by the length of their sides and checked by the crossing of the additional lines at the points indicated in the field book. Outside each external line will be an offset piece between the chain line and the boundary; this is plotted by co-ordinates—that is, distances and offsets. For example, the field book shows one of the lines thus:

2	2·92	⊙
8	2·30	
15	1·80	
12	1·20	
19	0·50	
7	0·00	⊙ $\frac{2 \cdot 40}{2}$
	(3)	

meaning that it is line 3, and the approximate direction is down to the right after leaving line 2. A station occurs at the commencement of the line shown by a circle with a dot in it, the same station having previously occurred at 2·40 on line 2, and the boundary is on the left of the line at a distance of 7 links square to the chain. At 0·50—that is, 50 links along the chain line—the boundary goes out to 19 links, at 1·20 (1 chain 20 links) it comes in to twelve links, then goes out again to 15 links at 1·80, at 2·30 comes in to 8 links, and at the end of the line at 2·92 it comes in to 2 links. These distances and offsets plotted to scale are shown in the accompanying Fig. 1; the small circles show stations, the large circle with the number in it gives the number of the line, and the arrow-head shows the direction in which it was measured. In practice the offset lines are usually omitted, points being made in the right places and the boundary sketched through. When the whole plan is plotted the chain lines are put in red (crimson lake) and the boundaries in black (Indian ink) and the pencil lines rubbed off. Then equalising lines are drawn through the boundaries and a new set of triangles laid down on the plan, as in Fig. 2. The base and perpendicular of each are measured by scale, and the calculation of area is made from the dimensions so found.

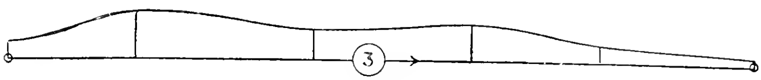


FIG. 1

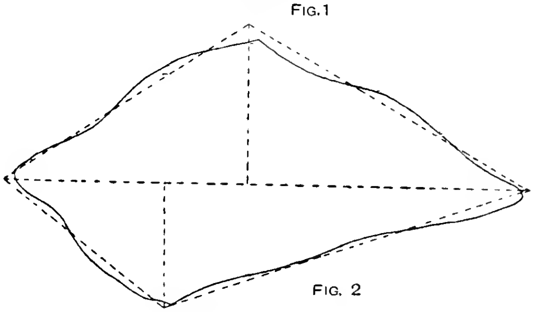


FIG. 2

Plotting a Survey.

Particulars of Diamond Drill.—In a diamond drill a small diamond is used as the cutting agent. The drill may be made of a bit of steel or a thin brass tube, into the end of which a sharp splinter of diamond is fixed by embedding in lead.

Sharpening Bandsaws.—When sharpening a bandsaw, each alternate tooth should be sharpened from its own side. A screeching noise is sometimes caused when working the saw by the teeth not being uniform in length, by uneven set, by too much bevel, or by excessive rake. Strip the points of the teeth by passing over them a topping file, which will make the teeth uniform in length. File up to a sharp point, and shoot the file so as to give the face of the tooth but little bevel and very little rake; in fact, the front of the teeth should be nearly upright. The teeth may be set with a small hammer on the bevelled edge of a small iron anvil. Secure the anvil in a vice, lay the saw flat on the anvil, and strike every alternate tooth from its own side.

Relaxing Birds' and Squirrels' Skins.—The following is a method of relaxing birds' and squirrels' skins. Half fill an earthen vessel with sand that is damp but not actually wet. Wrap each skin in a clean rag and place it on the damp sand; then cover with more damp sand, cover the whole with a damp cloth, and place in a shady place. In the course of, say, two or three days remove the top sand and examine the skins. If the feet and wings can be spread out by gently working them, they are ready for stuffing. If a number of skins are to be relaxed it might be advisable to procure a special relaxing box. Birds and squirrels are much more easily mounted fresh. Relaxed skins dry very quickly, and many have a wooden and unnatural appearance when stuffed.

How to Make a Prawn Trap.—The prawn trap shown by Figs. 1 and 2 consists of an iron hoop from 18 in. to 24 in. diameter with a shallow net attached.

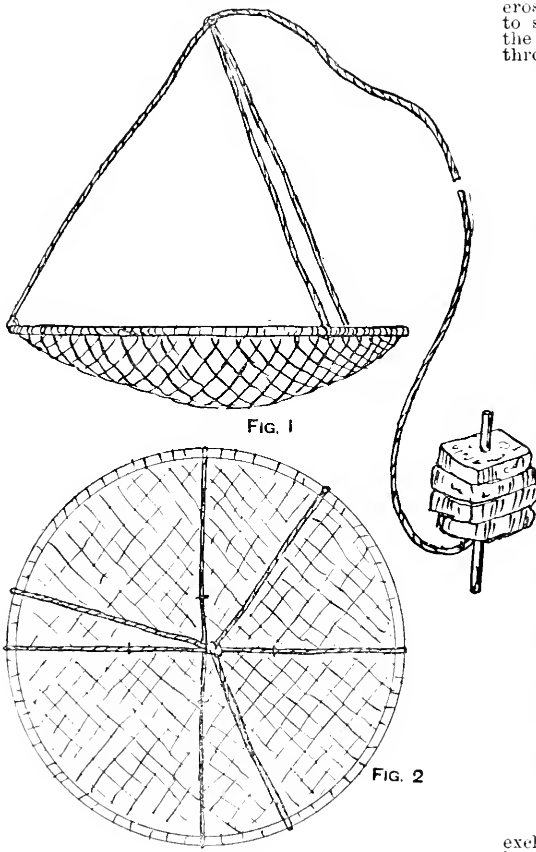


FIG. 1

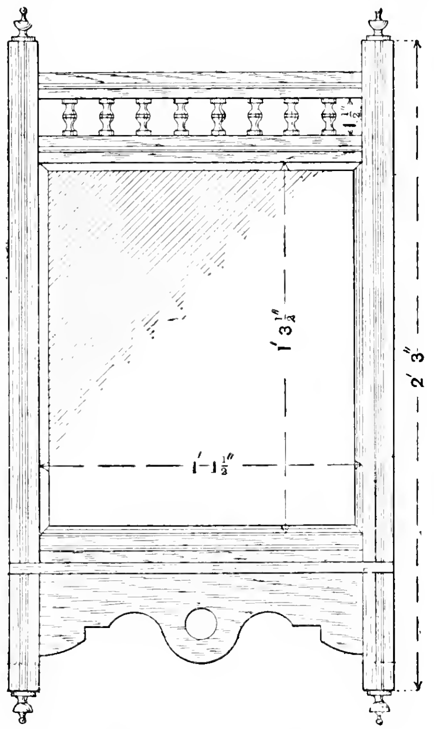
FIG. 2

Prawn Trap.

Across the net two strings are stretched (see Fig. 2) to which the bait of fish offal is tied. The hoop is connected by means of three cords to a line (see Fig. 1), and on this line, when fishing from a boat, a large cork float is attached to regulate the depth. When the trap is thrown from a pier the float is not used. The traps are pulled up occasionally, when the prawns may be found clinging to the bait.

Cleaning Heads of Stuffed White Birds.—The following instructions are on restoring the heads of two stuffed albatrosses to their natural white colour. The heads should first be well dusted with feathers. The after treatment depends on the nature of the dirt. If blood is present it may be removed by rubbing down with flannel dipped in water containing a little salt; then rub with turpentine and afterwards with benzoline, and while still thoroughly wet dust over plenty of plaster-of-Paris to absorb the benzoline and with it whatever dirt has been left. The following is an American plan: Dissolve a piece of pipeclay the size of a walnut in rather less than 1 pt. of warm water; well wash the bird with soap applied by a soft flannel dipped in the liquid. When clean, wash again in clean water and roll in a cloth to dry. Then hold in front of a fire and beat briskly with a folded towel. This method should not be adopted with a valuable skin; instead, after the washing, apply benzoline, then plaster, and beat with feathers in preference to a towel. Without this beating the bird would probably dry rough.

A Bath or Lavatory Mirror.—The frame for the bathroom or lavatory glass here illustrated may be of birch or some hard wood. The moulding can be worked in two lengths of 6 ft., 1¼ in. by ¾ in., which will allow for jointing, cutting, etc. A ¼-in. bead is run through the centre on the face side; this can be done by a beading plane with adjustable fence, or by a hand scratch tool. A rebate is worked on one edge ½ in. wide by ⅜ in. deep. The cross rails are secured to the uprights by mortise-and-tenon joints. The top spindle rail is not rebated, but is left with a square edge all round. The shelf is ½ in. thick by 4 in. wide, screwed to the under side of bottom cross-piece. The tail-piece is made from ½-in. stuff, sawn to shape with a bow or compass saw and secured to the frame with a couple of nails at each side passing through the uprights. The spindles are 1½ in. long



A Bath or Lavatory Mirror.

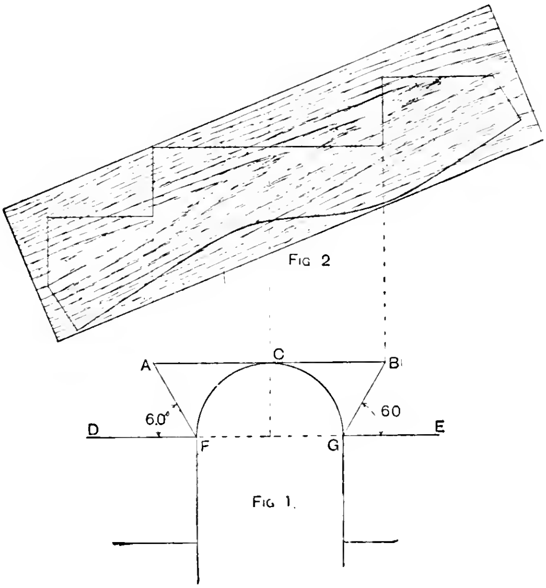
exclusive of dowels, and the tips are 1⅞ in. long and 1¾ in. in diameter, the dowels fitting into holes bored in the ends of the uprights and spindle rails. The mirror is 1 ft. 2½ in. by 1 ft. 4½ in., a stock size with some of the large dealers. The bevelled edge improves the appearance. The frame can be stained and polished, or left in the natural wood. A method of hanging is not shown, as ways will suggest themselves according to the position the glass has to occupy.

Aperture of Stops in Photographic Lens.—The figures of the following lens stops, $f/4$, $f/5{\cdot}6$, $f/8$, $f/11{\cdot}3$, $f/16$, $f/22$, $f/32$, $f/45$, and $f/64$, represent fractions of the focal length, or, roughly, the proportion which the diameter of the stop bears to the distance between the stop and the ground glass when a distant object is focussed. To state the diameter, therefore, it is necessary to know the focus of the lens. Focus an object its exact size, measure the distance between the object and the ground glass image and divide by four. This gives the equivalent focus, and avoids the necessity of measuring from the optical centre. If one is substituted for f, calling it ¾ in., etc., it is merely necessary to draw a line equal to the focus and divide it into this number of equal parts to obtain the diameter. This is not scientifically accurate, as there is a slight condensation of light by the front lens, but it is near enough for all practical purposes.

Injurious Gases from Gas Works. In the manufacture of sulphate of ammonia, the gas liquor, containing sulphide, hyposulphite, cyanide, and other compounds of ammonia, is heated first alone and then with slaked lime in an automatic still, and those compounds which are volatile, *e.g.* sulphide and cyanide, pass over along with the free ammonia through a pipe and bell-shaped exit into a tank containing sulphuric acid. The ammonia is absorbed by the sulphuric acid, leaving sulphuretted hydrogen and hydrocyanic acid free, and it is usual to connect the bell-shaped exit to a purifier, in which the gases are absorbed; if this is done there will be no escape of injurious gases.

Use of Zinc Dishes in Photography.—Enamelled zinc dishes may be used for fixing, developing, or hardening, but as the enamel coating is always liable to have minute holes in it, the dishes should not be used for any solutions that may be reduced by the bare metal. Strong solutions of powerful alkalies will in time destroy the enamel.

Development of Staircase Well.—When developing a well for a half-space landing, first draw the plan of the well, as shown at Fig. 1; then through C draw the tangent A B, of course parallel to D E. Then set



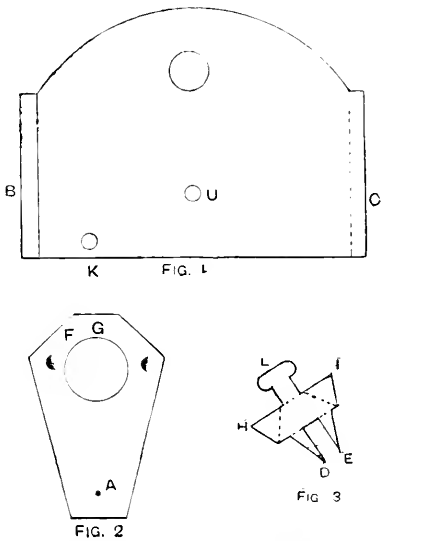
Development of Staircase Well.

off lines F A and G B at 60° to D and E respectively, as shown; then the line A B, for all practical purposes, will be equal to the semicircle F C G. From this the development of the well—that is, the shape of the veneer—can be set out as represented at Fig. 2, which shows how the thin board would be marked out before being bent over the cylinder.

Particulars of Corundum.—Corundum is a simple mineral, also called adamantine spar. Its specific gravity varies from 3·975 to 4·161. It contains about 90 per cent. of alumina, a little silica, lime, magnesia, and water. It is insoluble in acid, infusible by the blowpipe flame, but fuses gradually when heated with flux. It is generally found in ill-defined crystals, or acute and obtuse hexahedral pyramids, and is of a pale grey or greenish colour, also blue, red, and brown. It ranks in hardness next to the diamond, the sapphires being the blue variety and the oriental ruby being the red. It is found in India and in sands of rivers and alluvial matter in Ceylon. Common corundum is found in granitic rock in India, Mont St. Gothard, and Piedmont. The granular variety, containing peroxide of iron, is the emery of commerce, found in the Isle of Naxos in rolled masses at the foot of primitive mountains.

How to Cut a Cracked Glass Shade.—Suppose a glass shade to be cracked at the bottom for about 1½ in. up, and that it is desired to cut off the cracked portion without breaking the top part of the shade. First make an ink mark round the shade a little below the end of the crack. Now obtain a tube with a fine jet—a mouth blowpipe will do, or a glass tube drawn to a fine point, or even the mouthpiece of a clay pipe. Connect this to a piece of rubber tube and thus to a gas bracket. Now light the gas, keeping the flame as small as possible. Lay the shade on a table with the crack uppermost and place the flame between the crack and the ink mark: hold it there a moment, then raise it, and as the crack moves along, keep touching the glass carefully with the flame and lead the crack completely round the ink mark. At the end of about five minutes it will be possible to remove the cracked portion. To finish, carefully touch up the sharp edges of the shade with a piece of emery paper.

Making a Cheap Time and Instantaneous Shutter.—An inexpensive time and instantaneous shutter suitable for a magazine hand camera may be made of cardboard as follows. Cut a piece of stout pliable card—a good photographic mount answers well—to the pattern shown in Fig. 1. Next cut a piece like Fig. 2, and attach at A to the first piece on the underside with a stud or rivet U. Bend under, flat, the two pieces B and C (Fig. 1), and attach to the inner board, thus forming a support, and leaving a space for the shutter to work in. Now cut in thin metal a piece like Fig. 3, and bend on the dotted lines. Force the points D and E through the card at F and G (Fig.



Making a Cheap Time and Instantaneous Shutter.

2), and turn these and the flaps H and I down flat, thus holding it firm. Fasten a piece of fine black cord to H and I, and bring through the two opposite sides of framework, and fasten outside a button or bead. By this means the shutter may be pulled from side to side. Now fasten a rubber band by a slip-knot through K (Fig. 1), and put the other end of the loop over L. If the shutter is now pulled over by the right-hand button it will need only a slight pull of the left to cause it to spring across and give an instantaneous exposure. Time exposures may also be given.

Making Malt.—Malt might be made in small quantities from barley, but care is required. The barley is soaked in water for from forty-eight to seventy-six hours, according to the time of the year. It is placed in heaps till it becomes dry to the touch, the temperature rising by the growth of the barley; after about ninety-six hours the heat has risen to the full, and the acrospire or young shoot is visible on splitting the grain. The heaps are now spread flat on the floor and turned over about twice each day, the temperature of the rooms being about 60° F. The young shoot appears from the barley in a few days and dries away after about twelve days. The malt is now moved to the kilns and spread in layers, the heat varying with the kind of malt required—for pale malts 90° to 100° F., rising to 145° to 165° F. The heating in the kiln requires one or two days. In mashing the malt with water, the water is previously heated to 160° to 170° F.; it is not necessary to keep that temperature up for long, but it may be allowed to fall slowly; on no account should the temperature be allowed to go higher than stated above.

Fitting the Head of a Landau.—The accompanying sketches show how the framework of a landau head is fitted up, and also a plan of the position of the hoop-sticks when fixed in place. First get out the top pillars A, A (Fig. 1), which are 2 in. thick by the width of the door pillar at the bottom or hinge end, tapering to 2¼ in. wide at the top, and the cant rails B, 2½ in. deep, straight on the inside, to come flush with the pillars on the outside, sweeping out to the side sweep of the body; then cut the top part of the body standing pillar to a taper, to take the hinge C, so that it comes flush with the back of the pillar A, being careful to see that the face of the pillar A is kept level with the inner face of the door pillar at D, so that the glass frames will work freely. The hinges C having been turned to the proper depth so that the knuckle joint comes fair in the centre of the joint formed by the two pillars, fix them in place, keeping the outer edge ⅝ in. in from the outside of the pillar, screwing them on so that the joints line straight across both ways. The top pillars are now fitted to these hinges, temporarily at first; see that they are perfectly square from both faces. Mark off the height of the head, which should be sufficient to give a clear distance of 3 ft. 6 in. from the top of the seat to underneath the hoop-stick, and fit in the cant rail B. The cant rail should not be cut until it is practically finished; it is attached to the pillars by two hinges, which are sometimes let into the top part, and at other times on the inside of the rail, according to the make of fittings used; see that each corner works square and true with the pillar, or the head will never close properly. After the pillars and cant rails have been cleaned off to the body, they are boxed out for the glass course, marking the pillars by the course already made in the doors (which is generally about 1½ in. wide, tapering towards the top to full ½ in.); it is taken out full ¼ in. deep, and should be a trifle deeper than the course in the door pillar, to allow for the body closing in: the cant rail is boxed out to line with the pillars, ⅞ in. deep. Run the quirks on the outside, cut the joint in the cant rail E, and let in the dovetail catches on the top to keep it in place. To prevent it opening whilst fitting up the other parts, tightly fit a slip of wood in the glass course, fixing the two halves of the cant rail to it with screws. Having fixed on the pillars and cant rails for good, and having seen that they line with one another, fix on the two centre hoop-sticks F, F (Fig 3), which are 3 in. wide by 1 in. thick, and are planed off at the ends so that they fit flat on top of the cant rail. The front one is kept over the joint in the cant rail until it lines with the male part of the dovetail catch, a clear space of ⅜ in. being left between the two hoop-sticks to allow room for the cloth and lace trimming on the edge. To fit up the narrow hoop-sticks G (Fig. 3), it is necessary to fit around the top part a frame or scaffold, indicated by the dotted lines H (Figs. 1, 2, and 3); the top ones are 1½ in. deep by 1 in. thick, true to the side sweep of the body on the inside edge, fixed to the cant rail by a screw, in line with the top of the wide hoop-sticks already fixed. At the corners, strips I (Figs. 1 and 2) are screwed on at the top, being fixed to the back and front rails at the bottom (see Figs. 1 and 2), when the top line of the frame should have a drop of 1 in. from a straight line, and a sail out in length of 1 in. beyond the square line, both back and front. To keep the frame its proper width, two laths K, K (Fig. 2) are tacked across at the back and front, afterwards testing for correctness with a wax line. The slats L (Fig. 1) are now got out, the front and hind ones being slightly curved at the top, full 1 in. thick by the width of the hoop-sticks G (Fig. 3) at the top, tapering to nearly the width of the slat-iron M (Fig. 1) at the bottom; they are very slightly swept on the outside, and in fitting them up they have to rest against the framework at the top and on to the slat-iron at the bottom; this gives a twist to the two bearings, which is worked out a good bit

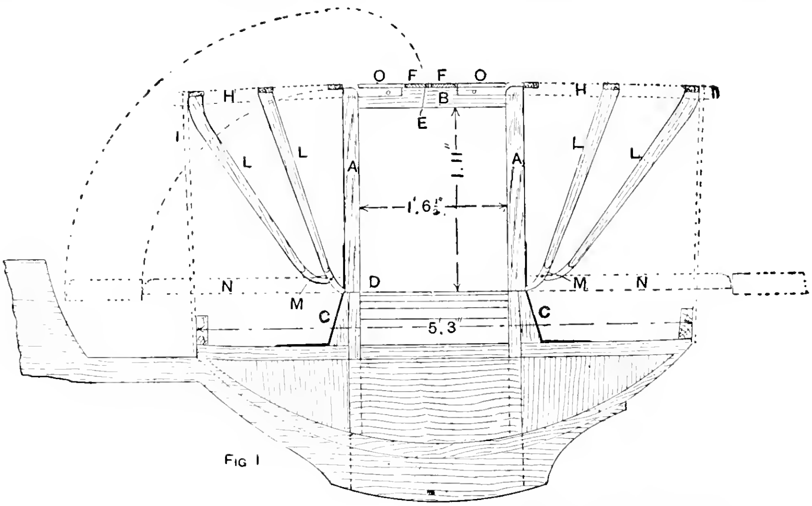


Fig 1

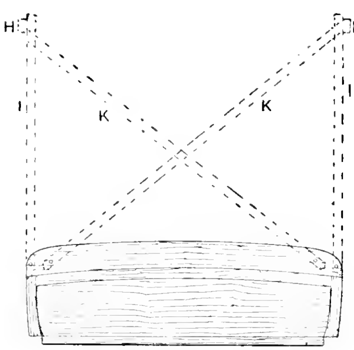


Fig 2

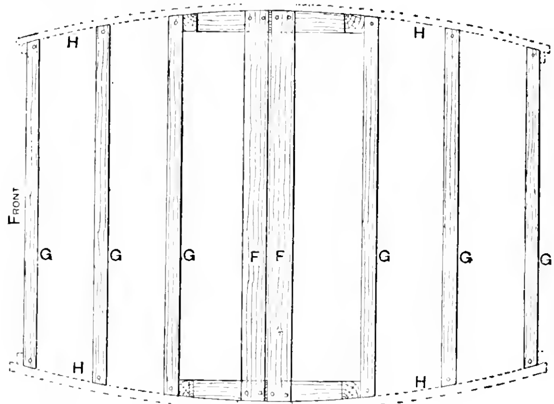


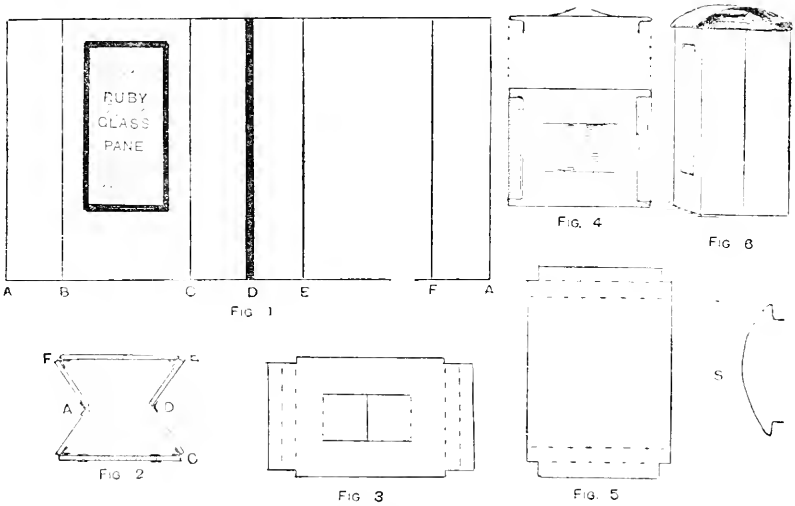
Fig 3

Fitting the Head of a Landau.

in rounding them up. At the top they are kept ¼ in. below the top edge of the frame, the hoop-stick making up, when let on, the remainder. The slat-sticks are rounded off at the bottom end about 1¼ in. below the last screw-hole in the slat-iron, but should not be fixed for good until the whole is fitted up. In some cases it is necessary to fix on a small corner block behind each pillar, to carry the first narrow hoop-stick; in other cases a flap is left on the fitting, to which they are fixed. Having got them all in place, hold a long lath flat on the centre hoop-sticks, press down each end, and see that it bears fair on each stick; should it not do so, alter the fixing on the slat-iron either up or down, as may be required. After it is correct, tack on two strips of webbing from the centre hoop-sticks over the others on to the cross rails of the body, keeping it tight and tacking to each hoop-stick; take away the frame round the body, loosen the screws in the strips in the cant rail, lower the head to see that it works all right, when the pillars should be as shown at N (Fig. 1). If all is correct, put it back in its place, securely fix the slats to the irons, put on the filling-up pieces O (Fig. 1) on top of the cant rail level with the hoop-stick and flush with the end of the rail, this and the top corners of the hoop-sticks being canvased about 7 in. each way, and the bottom of the slat sticks 9 in. or 10 in. up, when it is ready for the trimmer. It should be mentioned that the whole of the hoop-sticks and slats should be well rounded in to prevent the cloth or leather from being chafed, and in cases where a large front light has to be fitted the front hoop-stick is much heavier than here given.

Preparation of Mercury Chlorides.—The two chlorides of mercury are mercuric chloride ($HgCl_2$) and mercurous chloride ($HgCl$ or Hg_2Cl_2). The first is often called corrosive sublimate, and the second calomel. To prepare mercurous chloride, dry mercuric chloride, mercury, and a common salt solution are rubbed in a mortar to a uniform mixture, which is sublimed, that is, evaporated by heat, and the calomel is condensed in steam or air. Another method is by placing solution of mercurous nitrate in a dilute solution of common salt; the mercuric chloride in the white precipitate resulting. It must be thoroughly washed in water, and dried. Mercuric chloride is often produced by the evaporation of a mixture of dry common salt and mercuric sulphate in equal parts. Or metallic mercury may be heated in chlorine gas; or hot hydrochloric acid may be used to dissolve mercuric oxide (red precipitate), when the required material crystallises out on cooling.

Lamp for Photographic Dark Room.—To make the lamp here illustrated, cut two rectangular pieces of cardboard 8 in. by 4 in. and four pieces 8 in. by 1¼ in. In one of the wider pieces cut out a piece for the window about 5 in. by 2½ in., and fit in a piece of ruby glass, secured by lantern slide binding strips stuck on both sides. If ruby glass is not available, gum two thicknesses of orange paper over the space. Then lay this piece on the table (inside uppermost), with one of the narrow cards on each side of it, and join the three together with a binding strip over each joint, making the ends square. While this is drying join the three remaining cards in the same way, the wide one being in the centre. Then turn both parts over, adjust evenly, and join again, when the whole will appear as in Fig. 1, where the blacker line at D shows the binding strips in view, the joints B, C, E, F, having been joined on the other side. Next join the ends A, which is done by holding them over a flat ruler while sticking on the strip. These strips act as light-tight hinges, so that the whole will fold up flat, as shown in section partly closed in Fig. 2. The letters at the joints in Figs. 1 and 2 correspond, and make this quite clear. For the bottom, cut a piece of tin 4½ in. by 1 in. and turn the edges up ¼ in. full all round, snipping out the corners. This will make a tray that will fit loosely *inside*. To make the top, cut a piece of tin to the shape shown in Fig. 3, bend at the broken lines and cut at the full lines, so that it appears as shown by Fig. 4. The edges projecting downward will be 3¼ in. apart, to fit *inside* the lamp (see section, Fig. 4). The flanges bent up form light shades in one direction for the ventilation hole. A second piece of tin will shade in the other direction, and this must be cut as shown in Fig. 5, and bent along the dotted lines, and slightly curved as at S. This will slide over the first tin, and the flanges of the lid will meet at the corners, and, being 3¾ in. by 3¼ in., will fit comfortably in the top. The tray bottom and lid cover keep the card sides extended as shown in Fig. 6. When packed up, the tray and cover will fit into each other, and the sides fold up flat.



Lamp for Photographic Dark Room.

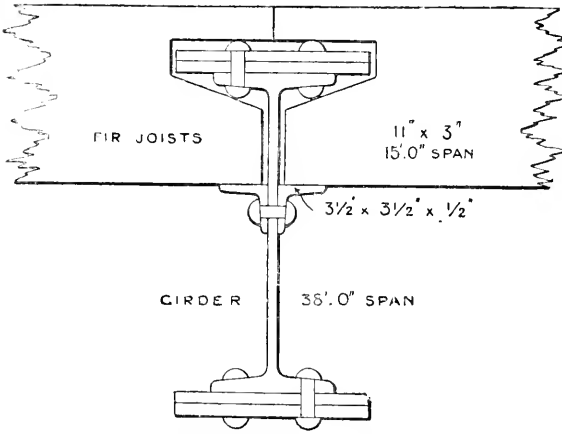
Preparing Gelatine for Casting Trusses.—Gelatine suitable for casting trusses should be of good quality, costing 1s. to 1s. 6d. per lb. Soak the sheets in a bucket of cold water till soft, and then melt in a vessel surrounded with water like an ordinary gluepot, adding sufficient water to make the mixture just thin enough to pour easily and yet enter into all the small details of the ornament. The gelatine must not be used too hot, or it will stick to the mould, however well the latter may be oiled. Allow the can to become sufficiently cool to be handled without discomfort before using.

Injurious Gases from Manure Works.—The gases evolved in the manufacture of artificial manure are carbonic acid, sulphurous acid, sulphuretted hydrogen, hydrochloric acid, and, according to some, arseniuretted hydrogen and silicon fluoride, also sulphuric acid in the form of spray. These gases are certainly injurious, and in small quantities will lead to bronchial and other affections, and to poisoning if inhaled in large quantities. The operation of dissolving is, however, carried on in a closed mixer and pit in which a fan is placed, and the gases are drawn through towers in which blocks of wood loosely packed are arranged, and these blocks are kept wetted by water sprayed from above; by this means the harmful gases are dissolved out before the air is passed into the chimney. In a properly constructed superphosphate works there will therefore be no nuisance from the escape of gases.

Cleaning Gold Braid.—Gold braid only slightly discoloured may be cleaned by beating it with a soft brush dipped in fine whiting, calcined magnesia, or fuller's-earth. If badly spotted and blotched, the stains may be removed by carefully brushing with a brush dipped in a warm solution of potassium cyanide—1 dr. to ½ pt. of water—then in clean warm water. If the braid is of poor quality, all attempts at cleaning will only make its appearance worse.

Safety Valve on Hot-water Apparatus.—The position in which the safety valve is on the primary return is generally considered as good as any. There is no doubt, however, that theoretically the ideal place for a safety valve is directly in the boiler, which is the seat of danger; but this position is seldom available, and at best the valve would be out of sight, and this is not desirable. The valve is therefore connected to the boiler by a pipe that will not readily become stopped up. The flow pipe is the least desirable position, as in hard-water districts the pipe is apt to choke with deposit. The return pipe is much less liable to choke. Perhaps the best way is to connect to the boiler by an independent 1-in. pipe, screwing this through the top of the boiler so that it projects down about 1 in. inside. It is not likely to be shelled over or stopped with lime deposit if done in this way.

Size of Girder to Support a Floor.—Suppose a girder is required to support a floor 38 ft. by 30 ft., the girder to run the 38-ft. way. A single girder of 38 ft. span down the centre of the room would require to be of steel, composed of a rolled joist 20 in. by 7½ in. by 89 lb., with two 12-in. by ⅝-in. plates on each flange, making the whole girder 22½ in. by 12 in. by 195 lb. per ft. The floor may then be carried by 11-in. by 3-in. fir joists resting on a 3½-in. by 3½-in. by ½-in. angle steel, riveted to web on each side, as shown in the accompanying illustration.

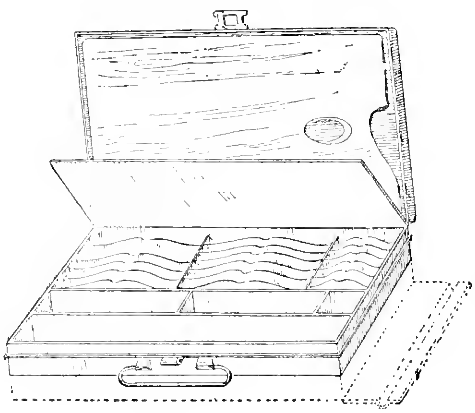


Girder to Support a Floor.

Cleaning and Polishing Brown Boots.—In cleaning all boots and shoes it is best first to put them upon trees; if unprovided with these, to fill them—or the forepart of them—with soft paper so that they can be the better rubbed. For brown leather that is stained by dirt in wear, all that is necessary, as a rule, is to wash it with a very soft brush or sponge and a little soap and water. If very bad, wash in the same way with Clark's mahogany fluid diluted well with water. Propert's fluid is also very good, but wants a little more care in using. Whichever is used, follow with an application of the same maker's cream. To keep the boots light, use white cream, unless any of the surface is worn, when it will need brown cream to bring it to the colour of the remainder. Sometimes dust accumulates on cream and mixes with it because the cream has not been properly applied, or because too much has been used. If the boots are on trees, the cream can be rubbed off with a dry cloth, but it is very hard work; and water, as above, will not hurt the leather if used carefully. To use the cream, have a very small portion on a piece of clean white flannel and rub it on the leather very lightly over a wide surface as quickly as possible. This is continued till all the boot or shoe has been gone over. Then start afresh, and go over it again and again in the same way, always working the pad with a circular motion. After the first cleaning, the front will need the most treatment, as that portion of the shoe gets more wear, and the bending of the foot throws the cream out of the pores of the leather, these brown goods being grain side out. The shoes will not need washing every time they are cleaned; but before they are creamed—in fact, every time they are taken off—they should be well dusted and polished with a soft cloth. After the cream has been put on one shoe, let it set while the other is creamed; then well polish with a soft cloth. This treatment preserves the surface of the leather.

Making Emulsion of Cod Liver Oil.—Suppose that one is making up an 8-oz. bottle of emulsion of cod liver oil; clean and dry the bottle, and weigh into it 20 gr. of gum tragacanth, moisten the gum with a very little spirit of wine, and allow it to stand for about an hour, then add 1 oz. of water and shake vigorously; this will produce a thick emulsion. Now measure out 3 oz. of water and 4 oz. of cod liver oil. add a small portion of the oil and again shake, add water and shake, and so on, until the materials are thoroughly mixed and emulsified. If it is intended to sweeten and flavour this mixture besides adding hypophosphites, make a syrup by dissolving 1 lb. of white sugar in 2 lb. of water; take 3 oz. of this syrup in place of the 3 oz of water, add to it from 20 gr. to 50 gr. of each hypophosphite before making into emulsion. The flavouring matter is oil of bitter almonds; it should be dissolved in a little spirit of wine, a few drops of it being added at the last so that there is just sufficient to give a flavour and no more. The emulsion can be made very quickly and thoroughly by placing the materials in a mortar or basin and employing an egg whisk.

Box for Oil Colours.—Herewith is a sketch of a colour box suitable for either studio or sketching purposes.



Box for Oil Colours.

The box, which is about 13 in. by 9 in. by 1½ in., is divided into compartments to hold twenty-three colours, oil, turpentine, dipper, and brushes. The palette is laid inside the lid. The dotted lines underneath show how the same sort of box may be made to hold two or three prepared millboards.

Mountant for Glazed Prints.—There is always a danger of losing the glaze when a water mountant is used, but an alcoholic solution of gelatine does not so affect them; it is, however, difficult to apply a thoroughly even coating. If the prints are backed with waterproof paper, ordinary mountants may be used, and the print mounted dry. Or rubber solution thinned down with benzoline may be used.

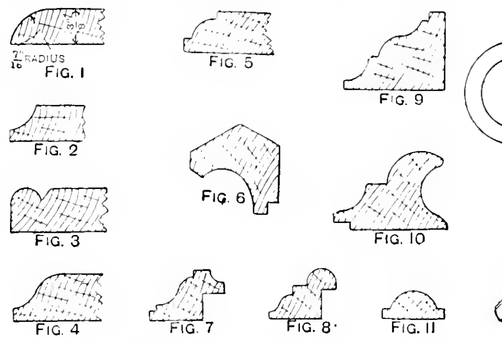
Making Stone Playing Marbles.—Ordinary stone marbles are mostly made in Germany. The stone is broken into pieces of the required size and thrown into a mill, where, beneath a kind of horizontal millstone, the angles are ground off and the pieces gradually reduced to shape.

Glazing Photographic Prints.—To glaze prints, carefully clean the glass, dust it over with French chalk, and rub well, finally polishing off every trace of chalk. Soak the print in water, and bring it in close contact with the polished glass under water. Cover the print with a sheet of blotting paper, and squeegee into close contact with a flat squeegee, and set up in a warm, well-ventilated room to dry. When bone dry, the prints should spring off spontaneously if one corner is lifted with a penknife. If the prints will not leave the glass without tearing, either the glass was improperly prepared or the prints were not thoroughly dry.

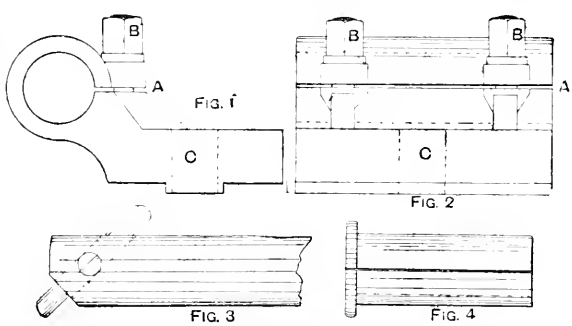
Renovating Crimson Velvet of Chair-seat.—The following is a method of raising the pile of a crimson velvet chair-seat cover. First take off the velvet covering, as probably there will be an under-cover of calico or hessian, and the stuffing will not be disturbed. Now heat an ordinary flat-iron and cover it with several folds of wet cotton cloth. Fasten the iron by the handle, face uppermost, in a vice, and as the steam rises pass rapidly the wrong side of the velvet backwards and forwards over the face of the iron; finish by brushing up the nap with a soft brush. Another method is to fill a clean tin can with boiling water, cork up, and lay it on its side. Slowly pass the velvet over the can, and as the steam comes through brush up the pile.

Estimating Load on Floors.—Floors should be estimated for according to the nature of the building and the probable load. A crowd of persons is variously estimated to weigh from 41 lb. to 147·4 lb. per square foot of the surface covered. Probably a safe average would be 1 cwt. per ft. super. considered as a live load. Dwelling houses are usually designed for a dead load of 1¼ cwt. per foot super., churches and public buildings 1½ cwt., and warehouses 2½ cwt. The weight of the structure must be allowed for in addition to the above loads, and this is most important to bear in mind in connection with fireproof floors.

Railway Carriage Mouldings.—The accompanying figures show a few of the sections of mouldings commonly used in railway carriages, but very many others are employed, especially on saloon interiors. Fig. 1 shows a coach round, Fig. 2 scotia, Fig. 3 coach bead, Fig. 4 ogee, Fig. 5 ovolo, Figs. 6 to 11 combinations of rounds, fillets, and hollows. The round shown by Fig. 1 is used on outside mouldings; Fig. 6 shows an outside cornice moulding where the roof boards overhang the side; Fig. 10 a cornice moulding to use over the cloth when the roof boards are cleaned off flush with the side; Fig. 9 shows an inside cornice moulding, and Figs. 7 and 8 are for inside doors and panelling. It will be noticed that the bead (Fig. 3) differs from that usually used in joinery in having a V quirk.



Railway Carriage Mouldings.



Tool-holder for a Slide-rest.

Cement Joints to Drain-pipes.—For jointing drain-pipes, cement mixed with a little sand is used. When the sand is clean and sharp, 1 part of sand to 4 parts of cement may be safely used, without detracting too much from the strength of the joint. To make a good joint, tarred gaskin should be first well caulked into the joint with a flat caulking tool, so as to prevent the cement mortar bulging up inside the pipe and forming a ridge. The length of time such a joint should be allowed to stand before testing will depend on the setting qualities of the cement, but with twenty-four hours' rest it should stand a head of 1 ft. of water. Two parts of Portland cement mixed with 1 part of lime and 6 parts of sand give a mixture twice as strong as one made of 1 part of lime to 2 parts of sand, while the cost is nearly the same. Such a mixture, however, would be too porous for jointing drains with. Four parts of cement, 2 parts of lime, and 1½ parts of sand would make a suitable mixture.

Body-horse for Coach-painters' Use.—The kind of body-horse most generally used in painting the bodies of carriages consists of a pair of good stout second-hand wheels, placed back to back and on top of each other, and four cross-bearers and castors. Procure a pair of wheels about 3 ft. 6 in. high, with 2¼-in. or 2½-in. spokes; see that the tyres are tight, so that the spokes will not work when the weight is put upon them. If the stocks are fairly large on the back end, clean them off true and flat; plug up the centre quite tight in each one. On the back of one fix an iron plate the size of the stock, having a 1-in. iron pin in the centre long enough to pass up through the other wheels, and fitted with a nut and thread at the top. On the face of the rim of the bottom wheel are bolted two cross-bearers about 4 ft. long, 4 in. wide by 1 in. deep, parallel with each other, having strong castors fixed on about 9 in. from each end. On the back of the top wheel is fixed an iron plate similar in size to the bottom one, with a hole through the centre to take the bolt fixed to the bottom wheel. The backs of the wheels are put together and screwed down by the nut on top of the bolt. On the rim of the top wheel are bolted two bearers similar in size to those on the bottom wheel. The body, when taken off the carriage, rests upon these, when the top wheel can be turned round to any desired position, or the whole moved where required by the castors on the bottom wheel.

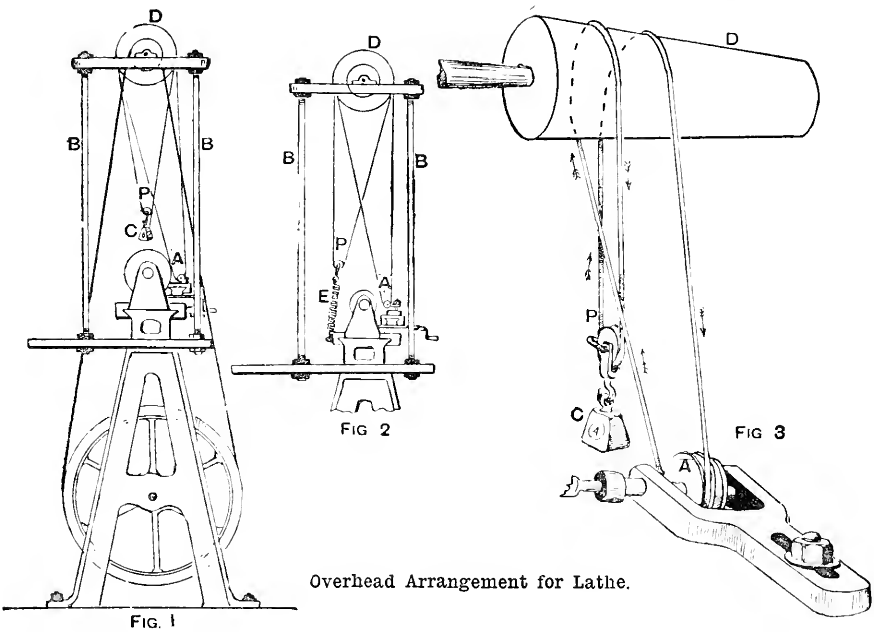
A Tool-holder for a Slide-rest.—Figs. 1 and 2 show a very handy American tool-holder for slide-rests, with a tongue to fit into the T-slot in place of the regular tool post. It can very easily be constructed to fit an English slide-rest by leaving off the tongue and having it planed flat on the bottom. In commencing to make it, the base of the iron casting being planed, the hole should be bored with a boring bar between the centres of the lathe with which the holder is to be used. A ¾-in. hole is about right for a 4½-in. centre lathe. The slot A (Figs. 1 and 2) is cut with a hack-saw, and clamping screws are shown at B. The dotted lines at C indicate the bolt hole for fastening the holder to the slide-rest. Fig. 3 shows a ¾-in. steel boring bar, which should have a total length of about 10 in. A ¼-in. tapped hole carries a grub screw, and a corner of the bar is filed off. The hole for the cutter should be drilled, the cutter being of $\frac{3}{16}$-in. square tool steel. Fig. 4 shows a split bush to hold a ½-in. bar; it has a milled end to facilitate removal. Several such bushes should be made to accommodate a variety of bars, and also one or more with the holes eccentric to the centre of the bushing to hold small steel. By that means it is easy to place the cutting point of the tool at any height required.

Tempering Gun-lock Springs.—In tempering small V-shaped springs for gun-locks, the springs must be made red hot over a clear forge fire, and then plunged into cold water and allowed to cool. They are warmed and rubbed all over with mutton suet, which is then blazed off over a clear fire and the springs allowed to cool. Be careful not to overheat the steel.

Detecting Adulteration of Milk.—A hydrometer graduated for specific gravity (a urinometer is suitable), also a 6-in. by 1-in. tube with a graduation at 5 in. and other marks, will be required in testing milk. Pour some milk into the tube and float the hydrometer in it; if the milk is pure the hydrometer will sink until the mark 1032 is just visible at the surface of the milk; watered milk will have a gravity below 1030, and, if very bad, 1020 to 1025; skimmed milk has a gravity from 1033 to 1035. Remove the hydrometer, fill the tube to the 5-in. mark, and leave it till the morning; then read off the number of divisions occupied by the cream. The divisions may be one-tenths or one-twentieths of an inch; if the former, then each division equals 2 per cent. of cream; if the latter, then each division equals 1 per cent. of cream. A good milk will yield 8 to 12 per cent. of cream or 3 to 4 per cent. of fat. The figures given above hold true for the majority of milks, but a little latitude must be allowed; for instance, if the percentage of cream is twelve, then the gravity may be below 1030, and yet the milk may be genuine, because the fat is lighter than the other materials. A full chemical analysis is really necessary for detecting slight adulteration.

Bluing Rifle Barrels.—Charcoal, crushed to dust, is employed for bluing steel gun-barrels. Iron can be blued as well as steel. The barrels must be very highly polished, and previous to being immersed in the charcoal dust, which is made hot, must be rubbed with whiting to remove all grease; after removal from the charcoal they are dusted with whiting. When being blued, and as soon as the colour is deep enough, allow the barrels to cool, after which oil them thoroughly.

Overhead Arrangement for Lathe. — The illustrations show a simple and efficient way of setting up an overhead shaft and fittings for driving revolving cutters as A in Figs. 1, 2, and 3. The uprights B (Figs. 1 and 2) may be of gas piping, the lower ends being fixed to the table and the upper ends having a cross-bar to carry the bearings of the overhead shaft, with drum D (Figs. 1, 2, and 3); a set of these supports is required at each end of the lathe. The chief part, however, is the tightening device. This consists of a pulley P (Figs. 1, 2, and 3) and hook with weight C (Figs. 1 and 3). Fig. 3 shows the arrangement clearly. The gut band or belt should be long enough to pass over the drum and pulleys. The weight keeps the band tight in whatever position the slide-rest may happen to be. Fig. 2 shows a modification with a spring E instead of the weight. The lower end of this spring should be fixed to the carriage of the slide-rest. The arrangement with the weight is easier to construct.



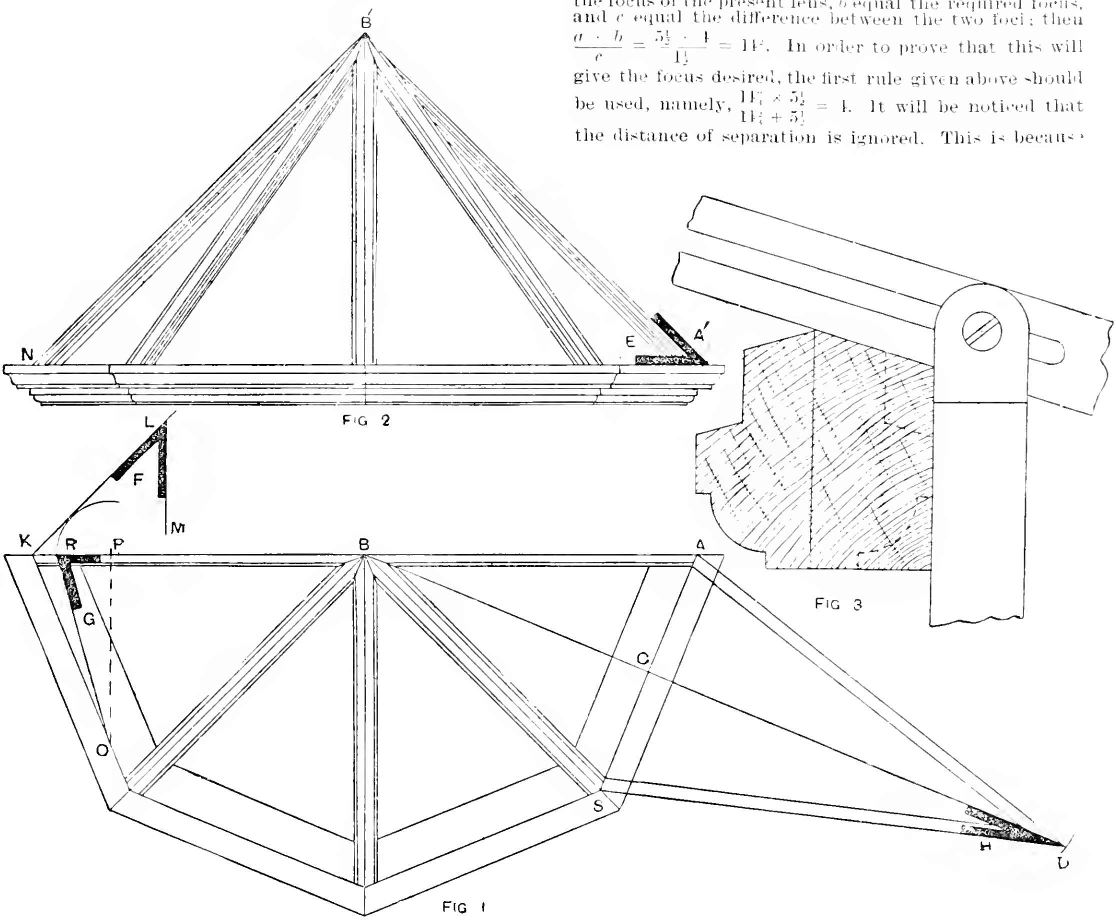
Overhead Arrangement for Lathe.

Engraving Designs on Gems.—Seal engraving is the art of sinking designs in intaglio on gems and hard stones. When the subjects are of an artistic kind the art is termed "gem engraving," and when a design is carved in relief it is called "cameo cutting." The tools and processes are similar in all three branches. The tools consist of small revolving wheels, the edges of which are charged with diamond dust, moistened with neat's-foot oil for hard stones, or with oil or water for soft stones, the polishing being effected with rottenstone and water. The object is held on a "cement stick," and is thus applied to the lower edge of a wheel. The sapphire is cut slowly but smoothly; the ruby is cut slowly, being apt to break off in small pieces, leaving a rough edge; carnelian and bloodstone are of close structure, and may be cut slowly. The softer stones can be cut with greater rapidity, but the effect is not so smooth as with harder stones, the amethyst being as soft a stone as can be engraved smoothly. When such soft substances as glass or marble are engraved, the tools soon deteriorate, the diamond dust embedding in the work and thus re-acting on the tool. The tools have long conical stems for fitting into the hollow mandril of a small foot-driven lathe-head. They are of iron wire, softened to take up the abrasive material easily, and around the stem of each tool is cast a tin or pewter plug that fits the lathe mandril. As the tools must run truly, they are fixed in the mandril and there turned. The general shape of the tools is that of a small disc more or less rounded on its edge, which is the cutting part, and which, for fine lines, is nearly a knife edge. For sinking large shields the tools are more rounded, and in some cases almost spherical. The rounded tool cuts more rapidly than one with a nearly flat edge, and is chiefly used for removing the bulk of the material, while the flatter edge is used for smoothing the surface. To allow the tool to be applied to sunken flat surfaces without the stem interfering with its action, the edge is made conical. The tools are seldom larger than $\frac{1}{10}$ in. in diameter, and are sometimes as small as $\frac{1}{150}$ in., very small tools being made by wearing down on rough work. To prepare the diamond dust it is mixed with olive oil. A small quantity is applied to the slowly moving tool; this is then moistened with some non-clogging oil, such as sperm or neat'sfoot. Stones to be engraved are often mounted on a handle about 5 in. long and $\frac{3}{4}$ in. in diameter, the cement being coated with sealing-wax to prevent adhesion to the fingers. If the stone is set, its setting is inserted in a notch in cork or bamboo cane. The surface of a hard, polished stone is roughened by rubbing on a soft steel plate charged with a minute quantity of diamond dust and oil, or, if the stone is soft, on a leaden plate with fine flour emery. The outline is then carefully sketched in with a brass point or scriber, and the surface within this outline is sunk. For dotting out an outline a small sharp-edged knife tool is used, a thicker tool with a rounded edge perfecting the outline; a still thicker tool is used for clearing out the material. The surface is finished with a smaller and flatter tool. Curved lines are more easily engraved than straight lines; and colour lines (or lines that show the stone surface between) are engraved with a tool having two knife-edges. The front edge cuts the required depth of line, while the second faintly marks out a parallel line; should the double-line tool tend to "run over," *i.e.* to overlap any previously cut outline, finish the lines with a single knife-edge tool. The work is watched during the cutting through a lens mounted in an adjustable stand directly over the tool, the work being brushed from time to time. The engraver, however, depends much on the sense of feeling for placing the work in respect to the tool, and upon hearing for judging of the progress of the work. An impression of the work is occasionally taken in a black wax made by mixing fine charcoal powder with beeswax, and an impression of the finished stone may be taken by dusting it with vermilion, cleaning its surface, and then pressing into hot red sealing-wax on a thin card or thick paper. So that the engraver's hands may be perfectly steady and free, he usually rests the palm of the left hand on the cap of the lathe headstock, while the forefinger and thumb embrace the revolving tool and grasp the upper end of the cement stick. The forefinger and thumb of the right

hand grasp the stick just below, and the right elbow is supported on a small cushion on the bench. When the engraving is finished, polish is restored to the surface by rottenstone and water on a pewter lap. The engraved surfaces of seals are not usually polished, but those of gems are finished carefully with copper tools charged with fine diamond dust. Boxwood tools with still finer diamond dust follow, then the copper tools with rottenstone and water.

Bevels for Hips to Semi-octagonal Lantern Light. —Figs 1 and 2 show the plan and elevation. The bevel for the bottom ends of the rafters will be the same as their rake, as shown at E (Fig. 2). The bevel to apply to the sides of the rafters at the top is obtained by drawing

of separation. Thus, with an 8-in. lens added to a 6 in. lens at a distance of 2 in., $\frac{8 \times 6}{8 + 6 - 2} = \frac{48}{12} = 4$ in. If it is desired in a fixed focus camera with lens of $5\frac{1}{2}$-in. focus and extension of 6 in., set for 8 ft., to include objects at 1 ft., it will be necessary to find the focus to which the present lens must be reduced. To do this, divide the distance between the lens and a near object by the extension (or the distance from the lens to the plate), which gives the ratio or proportionate size of the image. Multiply the whole distance by the ratio and divide the answer by the ratio plus one squared. Thus $12 \div 6 = 2$, the ratio. $\frac{(12 + 6) \times 2}{(2 + 1)^2} = 4$ in. To find the focus of the lens that must be used to reduce the $5\frac{1}{2}$-in. lens to 4 in., let a equal the focus of the present lens, b equal the required focus, and c equal the difference between the two foci; then $\frac{a \times b}{c} = \frac{5\frac{1}{2} \times 4}{1\frac{1}{2}} = 14\frac{2}{3}$. In order to prove that this will give the focus desired, the first rule given above should be used, namely, $\frac{14\frac{2}{3} \times 5\frac{1}{2}}{14\frac{2}{3} + 5\frac{1}{2}} = 4$. It will be noticed that the distance of separation is ignored. This is because



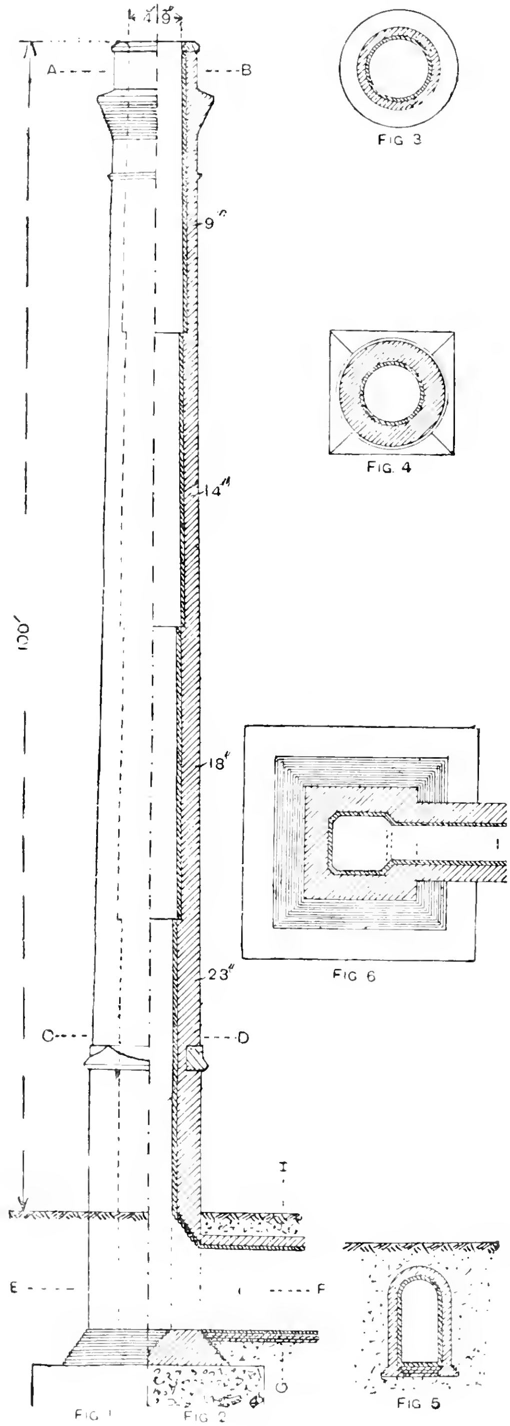
Bevels for Hips to Semi-octagonal Lantern Light.

from K (Fig. 1), K L parallel to B′ N (Fig. 2), and then by drawing the vertical line L M, giving the bevel as at F. At Fig. 3 is shown the bevel applied for the backing of the hips; this is obtained by fixing on any point P in K B and drawing an arc tangent to K L and meeting K B in R; from P draw a line perpendicular to K B, meeting K O as shown, and join O R, which will give the angle G required. To get the true shape of one side, bisect A S in C and draw the straight line B C D, then with the compasses set to radius A′ B set off A D. The joining of A D and D S gives the shape required. From this development the bevel for the top of the hips is obtained by the angle C D S as shown at H.

Use of Supplementary Lenses in Photography. —A convex lens added to another lens shortens its focus, and a concave lens lengthens its focus. To find the result of such a combination, multiply the two foci and divide the answer by their sum minus the distance

it is found convenient to use the lens inserted close against the front combination, where the separation is practically nil. The above focus need not be exact; 14 in. would be sufficiently near. The supplementary lenses should be preferably achromatic, but it does not necessarily follow that they will form an achromatic combination with the existing lens. Simple uncorrected spectacle lenses of varying foci may be used. For, although in any case the achromatism is upset by the addition of another lens, the difference is in most cases of no great consequence practically, unless the alteration exceeds about one-fourth of the focus. It is advisable, however, to use a smaller stop. A convenient method is to slip the lens (which should be shanked to fit with a pair of old scissors) into the hood and keep it in correct position with a ring of metal sprung in. But the most satisfactory method is to have the lenses mounted in a sliding frame made to pass through the tube against the diaphragm.

Sketch for 100-ft. Chimney, with Prices, etc.—The accompanying sketches show a 100-ft. chimney designed in accordance with the principles laid down on p. 149.



Design for 100-ft. Chimney.

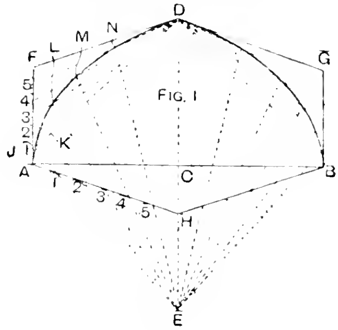
Assuming that it is for five boilers, each 30ft. by 7ft., and of about 50 horse-power, the chimney must be sufficiently large for 250 horse-power. The area in square inches $= \frac{100 \text{ horse-power}}{\sqrt{\text{height}}} = \frac{100 \times 250}{\sqrt{100}} = 2{,}500$; and this corresponds to a circle 4ft. $8\frac{1}{2}$in. or, say, 4ft. 9in. diameter. If the firebrick be not carried up to the top, the common brickwork will need to be $4\frac{1}{2}$in. thicker in each length. In Lancashire and the North of England generally the brickwork would be measured up and given as: *x* superficial yards common brickwork, 9in. thick, the price being about 5s.; *x* superficial yards extra for circular work about 3ft. radius, at about 1s. 4d.; *x* superficial yards (face measure) building to batter of 3in. in 10ft. at about 6d.; *x* superficial yards firebrick lining, half-brick thick, at about 4s. 6d.; *x* superficial yards extra for circular work about 2ft. $4\frac{1}{2}$in. radius, at about 2s.; *x* superficial yards (face measure) for building to batter of 3in. in 10ft., at about 4d.; *x* lineal feet building in stone basecourse, at about 1s.; *x* lineal feet neck mould, two courses deep, circular, at about 8d.; *x* lineal feet oversailing to chimney cap, sixteen courses deep, circular, at about 1s. 6d.; *x* lineal feet setting stone coping at about 1s. Fair prices for labour only would be for common brickwork, about 2s. 6d. per square yard, extra for circular about 8d., per superficial yard of batter about 4d.; per superficial yard firebrick lining, about 1s. 6d.; per superficial yard extra for circular work, about 8d.; batter in firebrick lining, about 3d.; per lineal foot building in stone base, about 4d.; per lineal foot neck-mould, 1d.; oversailing sixteen courses deep, about 1s.; stone coping, 1d. In addition to these the master bricklayer should add sums for labour to cover hoisting, alteration of scaffold, etc. Fig. 1 shows half elevation, Fig. 2 half section, Fig. 3 plan at A B, Fig. 4 plan at C D, Fig. 5 vertical section of flue at G H, Fig. 6 plan at E F. In Fig. 6, letter I indicates the flue from the boilers.

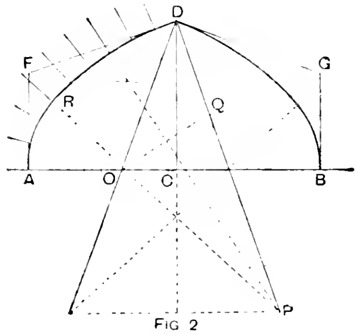
Particulars of Pigments used in Sign-painting.—The following notes may be regarded as supplying a summing up of the characteristics and properties of the pigments used in sign-painting. *Burnt sienna* is a rich transparent red-brown earth used for glazing over gold leaf and shading. It works well on gold leaf when mixed with a small quantity of ox-gall, and should be thinned with copal varnish, not turpentine; gold size may be used as a drier. It dries better than raw sienna, and is very permanent, as it is not liable to change by the action of light and oxygen, nor by damp and impure air. *Burnt umber* is a burnt Italian ochre. It dries well in oil, and is therefore often used as a drier. It is very permanent, and is sometimes used instead of vandyke brown. *Emerald green*, which is, perhaps, the sign-writer's special green, is a copper green upon a terrene base, very useful for brilliant work. It has not much covering power, and is a bad drier in oil, and therefore requires gold size or patent driers. It retains its colour well. The tube colour is the best. *Flake white* is a very pure white, not likely to discolour; it is on this account generally used as a finish over previous coats of white-lead. *Green lakes* are powerful colours, but not permanent. They may be purchased in bulk ready ground in oil, or in tubes. *Indian red*—peroxide of iron—makes pleasant tints with white, is permanent, and possesses great body. It may also be used as a ground colour, or as a shade tint with vermilion. For a quick-drying ground colour it may be mixed with turpentine 4 parts, varnish 1 part. *Indigo* possesses great body, and is a good glazing colour. It is not very durable, and is injured by impure air. *Ivory black* is made by placing ivory dust in a covered crucible exposed to a great heat. An inferior colour known as bone black is made by treating bones in a similar way. Ivory black, the deepest and purest of the blacks, being somewhat hard, requires very careful grinding, and unless ground very fine is useless. It is best ground in turpentine, and diluted for use with turpentine, gold size, and a little varnish. In drying it will become dull, so that it should not be used unless it is afterwards to be varnished. If thinned down too much with turpentine it will not bind, so that when the varnish is applied it will rub off on to the rest of the work and spoil the whole. Ivory black, when purchased unground, resembles "drops," and is sometimes called "drop black," but bone black is prepared in the same way. *Lemon and orange chromes*, when of best quality, are chromates of lead. They are brilliant, have good body and covering power, and make good tints when mixed with white. When used in oil they must be protected by varnishing, especially if exposed to impure air, which in time will turn them black. They make so-called gold colours, and must on no account be intermixed with Prussian and some other blues in making greens, as chromate of lead will destroy these pigments. The yellow chromes are made in three shades, known as Nos. 1, 2, and 3; the No. 4 shade is the orange chrome, a deep rich colour. The shades are varied by increasing the chromate for deep orange, and lessening it for the pale yellows. These colours are injured by damp and impure air, sulphur fumes, and hydrogen; but the orange chrome is said to last better

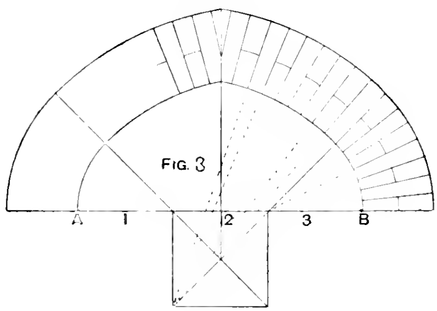
than orange oxide of lead. The chromes require skilful handling. *Prussian blue* is a good working and staining colour, and a quick drier. *Raw sienna* is rather an impure yellow, but has more body than the ochres and is also more transparent. By burning it becomes burnt sienna, which has the same properties. *Raw umber* is a good drying colour that does not injure colours with which it is mixed. *Ultramarine*, when perfectly pure, is most expensive, but the sign-writer generally uses *French ultramarine*, an inferior product, which will, however, stand when protected with oils and varnish. It may be deepened with vegetable black, and when mixed with white makes a pure tint. *Vandyke brown* is a rich, deep, transparent brown, and is a permanent colour good for glazing and for "markings" on gold. It is a bog earth, and not a very good drier. *Vegetable black*, which has taken the place of lamp black, is a light powder, and requires no grinding. Patent driers may be added, and it may be used on unvarnished work. *Venetian red* is cheap but permanent, and must be procured ready ground in oil. It is useful as a ground colour. *Vermilion* can be had as a fine dry powder, free from grit, and is a very brilliant colour in oil. The best quality only is permanent, and that is a sulphuret of mercury. Chinese red, or vermilion, is of a deep crimson tone, but has bad covering power, and, unless well protected, will soon fade under the action of light and impure air. *White lead*—one of the most frequently used colours and also one of the most faulty—is made by suspending rolls of ordinary thin sheet lead over malt vinegar or pyroligneous acid, in close vessels, the evaporation from the acid being kept up by a steam bath underneath. The lead is thus reduced to a white powder ready for being ground with linseed oil into a paste. White lead improves by keeping, and for good work should be stocked for at least twelve months after purchase. Very pale and old linseed oil should be used in the thinning, otherwise it will probably soon discolour. It is, however, about the best pigment for preserving wood, etc., from the effects of the weather. *Zinc white* is an oxide of zinc, but it does not possess so much covering power as white lead. It, however, does not discolour, and is a very pure pigment. *Yellow ochre* is not a very bright colour; it is best purchased in tubes, otherwise it is not thoroughly ground. It is an earth found in most countries, and is of all shades, from the warm yellow of the Oxford ochre to the pale straw yellow of the French earth; the latter is often used for "old gold" shades, etc. The ochres are not liable to change through any chemical actions, and may therefore be considered permanent.

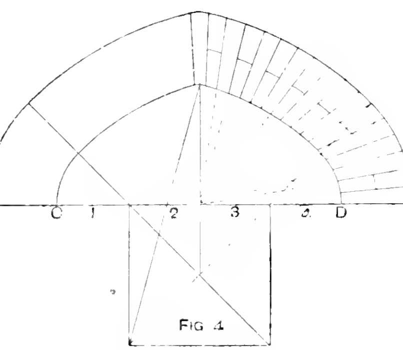
Combined Ebony Stain and Varnish.—A recipe for a combined ebony stain and varnish is the following. Take 4oz. of shellac, ½oz. of mastic, ½oz. of oil of turpentine, 4oz. of gum sandarach, 1oz. of Venice turpentine, 10gr. of camphor, 20oz. of methylated spirit, and ¼oz. of spirit black (aniline dye). Crush the gums, and put all together in a clean bottle; keep tightly corked, and well agitate till dissolved. Carefully strain, and apply with a camel-hair brush, and set aside in a hot room. Several coats may be given at intervals of half an hour. A harder finish may be gained by the aid of a japanner's stove, for which purpose it is best to buy the varnish ready prepared, as it has an oil varnish basis. A temperature of about 300 F. causes it to liquefy, settle into inequalities, and as the spirit flies off gives a hard, vitreous surface, which on the best class goods is afterwards smoothed down with finest-grade pumice powder, and the final brightness imparted with rottenstone and the hand.

Setting out an Elliptic Gothic Arch.—Figs. 1 and 2 show one method of setting out an elliptic Gothic arch. Referring to Fig. 1, bisect the span A B by the perpendicular line D C E, and make C D and C E each equal to the given rise of the arch. Draw A F and B G parallel to C D; and draw D F and D G, making the angles C D F and C D G each equal to half the given vertical angle. Take C H, equal to the difference between C D and A F, and join A H. Divide A H and A F each into six or more equal parts at the points 1, 2, 3, 4, 5. Through these points, on the line A H, draw the lines E J, E K, E L, etc.; and through those on the line A F draw the lines D J, D K, D L, etc., cutting the former in the points J, K, L, etc.; a curve drawn through these points with a bender will give half of the Gothic arch required. Referring to Fig. 2, having constructed the arch, make A O equal to A F, and draw D P perpendicular to D F. Make D Q equal to A O, and join O Q; bisect O Q by a perpendicular line meeting D P in P, and produce P O to meet the curve in R. Divide the curve A R D into equal parts, corresponding to the number of arch stones or bricks; then O will be the centre for drawing the joints to the portion A R, and P the centre for drawing the joints to the portion R D. Figs. 3 and 4 show other methods of setting out an elliptic Gothic arch. A given rise is not required with these methods, and the arch may be filled from the centres. Referring to Fig. 3, set off on the span three equal parts, and describe a square on the centre division and with the corners of square as centres describe the curves as shown. Fill in from the striking centres. In Fig. 4 the span C D is divided







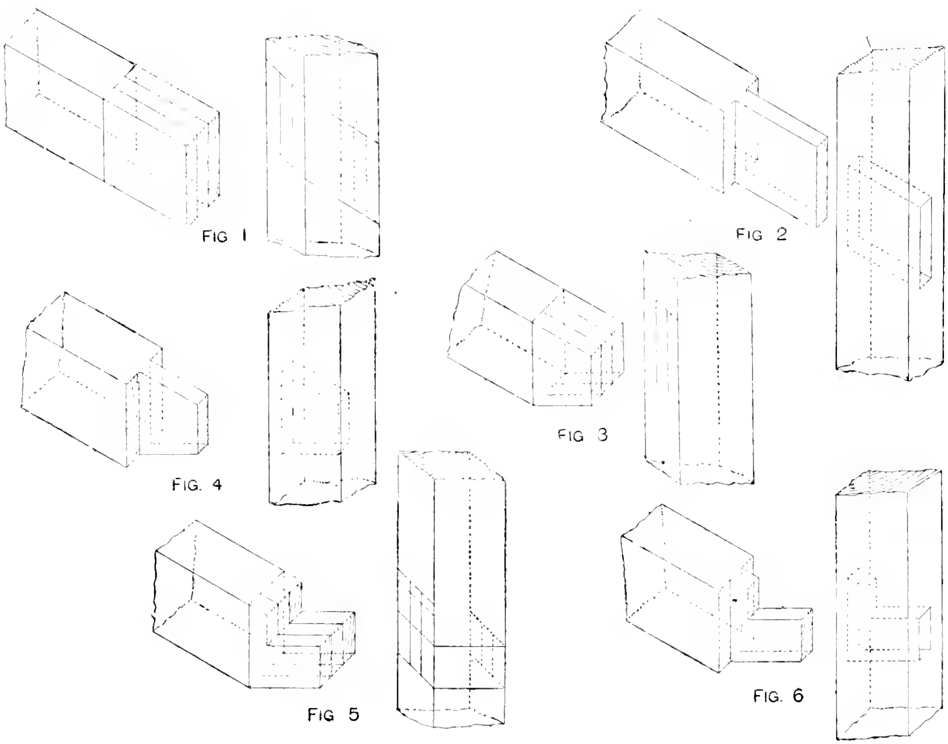


Setting out an Elliptic Gothic Arch.

into four equal parts, and a square is described on the two centre ones, the corners of the square being taken as centres and the curves described from them, as before. The arch may be filled in from the centre as shown.

Fumigating Oak Picture Frames.—When fumigating oak picture frames, first remove the pictures, glass, and gilt slips, then glasspaper the frames to free them from glue, grease, etc., and so arrange them in a box that the fumes will play freely round every part. The ammonia, in liquid form, specific gravity ·880, must be poured into saucers or shallow dishes, the box closed up, and every crevice pasted over with brown paper to prevent the fumes escaping; ½ pt. is sufficient for a box 9 ft. long, 6 ft. high by 3 ft. wide. The time of exposure varies according to the tone desired, generally from twelve to twenty-four hours. If possible, insert a pane of glass through which the action of the fumes may be watched. Wiping the frames over with strong coffee or lime-water will produce a tone closely resembling fumed work.

Oblique Mortise-and-tenon Joints.—The accompanying drawings show three ordinary forms of oblique mortise-and-tenon joints. In each case they are first set out ready for sawing and mortising, and then prepared for fixing together. The mortise shown by Figs. 1 and 2 is rather difficult to make, owing to it going obliquely through the wood. The joint shown by Figs. 3 and 4 would not be wedged, but fixed by gluing or pinning. Figs. 5 and 6 show a haunched joint which can be wedged.



Oblique Mortise-and-tenon Joints.

Removing Tar Paint from Gravestone.—To remove paint containing tar from letters cut in a gravestone, dissolve American potash, mix with sawdust, and lay it on the paint for twelve hours. Should this fail to allow the bitumen to be washed off, it may be so far softened by heat as to permit the superfluous black to be scraped off; and the letters can then be repainted. To make a good job of removing blacks marks from the level face of the stone, it will be necessary to grit the stone all over.

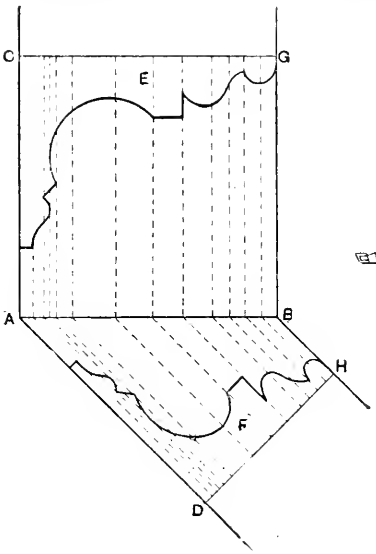
How to Make Wax Moulds for Plaster Castings.—A simple way of making wax moulds for plaster castings is the following. Mix together 3 parts of resin and 1 of beeswax by the aid of heat. Stir occasionally, to prevent the resin settling at the bottom of the pan. To ascertain whether the mixture is ready for pouring, dip the finger in cold water and then into the melted wax. If it can be held there for half a minute without any painful feeling, the wax is just right for pouring upon a plaster model, providing it is not too cold to run freely. If the pattern be a ceiling flower, fixed on a plaster plate ready for moulding, place it in water for about fifteen minutes; then take it out, and clear all superfluous water from the surface. Put a fence or wall of clay around it about 1 in. higher than the pattern, and then pour the wax upon the lowest part until it rises about ¾ in. above the pattern. If the model is a flat one, that is all that is required. Remove the wax from the model when cold. This is easily done if the model is placed in cold water. The mould is oiled with sweet oil once only during a day's work. For fine white plaster use Gallipoli oil; for new wax wash the mould with clear water after oiling it; for old wax dissolve a very small quantity of soft-soap in warm water, and with this wash the mould after oiling it. This will prevent any discoloration of the first casts from the mould. Holes and hollows will appear in the casts if the plaster is too thick to run into all parts. It should, when mixed, be no thicker than cream; and a good plan is to sprinkle the mould over with water; then brush the plaster well into every part, and fill out to the thickness required. Level the top edges, and place the mould in water for twenty minutes; then the casts can be taken out.

Mahogany Stain and Varnish.—A common plan of making the stain and varnish as sold at paint stores for imitation mahogany is strongly to impregnate burnt sienna with Bismarck brown—an aniline dye. The dye readily dissolves in water; the sienna gives it body. One pennyworth of each will make ½ gal. of stain. Spirit varnish varies in quality according to price; 4 oz. of orange shellac, 2 oz. of resin, and 1 pt. of methylated spirit will make a fair quality varnish. A red tinge is imparted by adding a small quantity of Bismarck brown.

Removing Sucker-valve of Lead Pump.—For removing the sucker-valve of a lead pump a sucker-rod is necessary. This has a tapering threaded point which is passed down the barrel and screwed into the lead clack, which is then pulled off the sucker; the harpoon end of the rod is then passed through the latter, and lifted out. By warming the tail end of the pump barrel the sucker can be lifted out much more easily.

Staining and Polishing Millboard in Imitation of Walnut.—Millboard may be given the natural appearance of walnut by the following procedure. Mix dry yellow ochre in 1 part polish and 3 parts spirit; apply several coats till a solid groundwork is gained. If the boards are very porous, the first coating may be glue size and ochre. A brighter undercoat can be obtained by using lemon or orange chrome instead of ochre. Smooth down with worn glasspaper. Mix umber in polish and spirit; put in some figure; for darker tones add vandyke brown, or black and red. Thin out with spirit if too strong, or to gain gradations of tone; use a camel-hair brush. Stipple in some heart or wavy portions. It is a good plan to have at hand a badger softener or clean dusting brush; as the colours are laid on they may be blended together, or at least any harsh appearance removed, by brushing or stippling the colours whilst still wet with the badger or dusting brush. Finally, smooth down again lightly, then apply a coat of spirit varnish with a trace of red stain (Bismarck) added. A second coat may be applied after an interval of half an hour. When dry, smooth down with glasspaper or pumice, then French polish or finish out with varnish.

Intersection of Mouldings.—The following is a method of getting the section of mouldings meeting in an obtuse angle when the mitre is square to one of



Intersection of Mouldings.

them. First set out the obtuse angle C A D, and mitre line A B; then draw the section of the main moulding as shown at E. Next draw line D H at right angles to A D; then from C G draw a number of ordinates parallel to C A, meeting A B as shown, and from where these meet A B draw the second series meeting D H as shown. Then by pricking off the distance of each ordinate from D H the same as its corresponding ordinate from C G, a number of points will be obtained through which the section of the moulding can be drawn as shown at F.

Lubricant for Cycle Chains.—A good, inexpensive, and easily prepared lubricant for cycle chains is a mixture of plumbago and vaseline. Any good make of blacklead will do, but specially prepared plumbago is better. Crush the blacklead to a fine powder and mix thoroughly with twice the bulk of good vaseline and a little lubricating oil. As all these lubricants are very "dry," they must be applied about every fifty or hundred miles.

Making a Parisian Phaeton.—The accompanying sketch shows an outline elevation of a double seat Parisian phaeton. In making the body the following parts will be required. For the rockers A six pieces of birch, 3 in. wide by $\frac{7}{8}$ in. thick when finished; two sham doors or pillars B, got out to pattern by $1\frac{1}{4}$ in. thick; two front and two hind pump handles C, $1\frac{1}{4}$ in. deep by $1\frac{1}{4}$ in. thick; and four rocker pieces D, $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in.; all these parts should be of clean, close-grained English ash, dressed up square and true. The rockers are halved together at the bottom to form the well of the body; the joint at the bottom must be made as shown, and fixed with four screws in each half-check from the inside. Be careful to get the correct bevel, and both sides alike. Before fixing together for good, box out $\frac{3}{4}$ in. for the bottom board and $\frac{1}{2}$ in. back and front for the heel panels. The hind pump handle C is halved into the sham door B from the inside to the same bevel as the rocker, with which it has to line, and the front pump handle is put into the front rocker piece D in a similar manner. The ends should be carved, and a chamfer made on the outer edge of the rocker pieces and the sham doors, and in some cases a quarter bead is run along the bottom edge of the pump handle. If the phaeton is to be painted, give all the joints a good coat of white-lead mixed with linseed oil only; if it is to be finished in the natural wood, put it together with gold size or a thick varnish. The rocker pieces and sham doors are now secured to the well with No. 14 screws, with the heads inside, keeping them flush with the inner edge of the rockers, and when in place the pump handles should line with one another and be just a trifle out of the straight line on the top; this is to allow for a little rise. Lay the side down flat, outside uppermost, and mitre in the bottom rocker piece D; this is also fixed from the inside, and a fine screw is inserted through each mitre into the side pieces. Two filling-up pieces are required on the pump handles *inside*, bevelled from the rocker to the pump handle to carry the edge plate; these may either be of steel round the well, or iron. Along the pump handles as far as the curved ends it is half round, $1\frac{3}{4}$ in. wide, feather-edge; and if a rumble has to be placed at the back, lugs should be welded into the plate to take an iron stay to support the rumble. Four

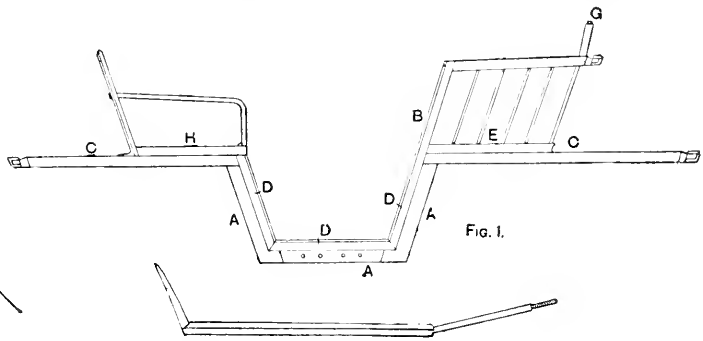


Fig. 2

Making a Parisian Phaeton.

$\frac{5}{16}$-in. holes are drilled along the bottom part of the plate to which the body steps are bolted. The plates are now screwed on, No. 14 screws being used around the well, and No. 12 screws along the pump handles. The two sides are next fixed together, a stretcher being placed across back and front to keep it the proper width; the bottom is first put in, then the front and back panels. Next place two strap iron plates across the bottom, and turn up each panel 3 in. The hind seat E, 1 ft. 6 in. wide, is now got out and fitted on temporarily; it comes flush with the outside of the sham door at the front, and is swept in towards the back about $1\frac{1}{4}$ in. each side; the elbows are got out to the same sweep as the end of the seat, are $1\frac{1}{4}$ in. wide by $1\frac{1}{4}$ in. deep when finished, and should line with the sail out of the sham door; they are half-checked on to the sham door, and are supported at the back by a square iron stay shaped as Fig. 2. The bolt end at the top passes through the raised back G, which is of 1-in. birch, swept edgeways in its length, 5 in. wide, and notched on to the elbows so that it is level at the bottom, being fixed in place by the bolt end on the corner iron and a small corner plate on top of the elbow and inside the raised back. The spaces for the sticks or iron rods should now be marked off. Measure the lengths required, and mark the direction of each one on the outside with a short straightedge; take apart, bore the holes for the pins $\frac{3}{4}$ in. deep, carve the ends on the elbows, put in the pins, and fix down the elbows and raised backs for good. The front seat H is made of 1-in. birch, 1 ft. 2 in. wide, and sufficiently long to overhang the pump handle $1\frac{1}{4}$ in. on each side, to which it is fixed by screws. The dash-board I is made of $\frac{1}{2}$-in. birch, fixed to the front edge of the seat, which is bevelled to the pitch, and by two half-round irons on the front, with a strong foot at the bottom. The side seat rail is made of $\frac{1}{2}$-in. round iron, and has a 6-in. half-round flap to fix it to the seat, and a round boss to take a $\frac{1}{4}$-in. bolt through the dash at the front.

Repairing Single-tube Cycle Tyre.—The method of repairing punctures is very similar for all single-tube tyres. First slightly enlarge the hole, inject solution, and then force a rubber plug (previously solutioned) into the hole. In some cases a number of specially made rubber rings are used instead of a solid plug, and the surplus projecting above the tyre is removed with a knife.

Fixing Wood Tester Head to Bedstead. — The sketches show how to convert an ordinary iron bedstead into a half-tester. Fig. 1 is a side elevation of a tester head, which might stand out from the wall, say, 20 in. or 22 in., giving room for a curtain. Fig. 2 is a plan of a tester head showing a square frame in red deal, say 4 in. by 1 in. The wall may be plugged and the back portion of the frame fixed to it with screws and an iron bracket (see Fig. 3). On this framework a moulding, say 4 in. or 1½ in. deep, should be planted, and carefully mitred at the corners. Screwed to the under part of the framework are two fretwork brackets of 1-in. wood, one on each side, cut

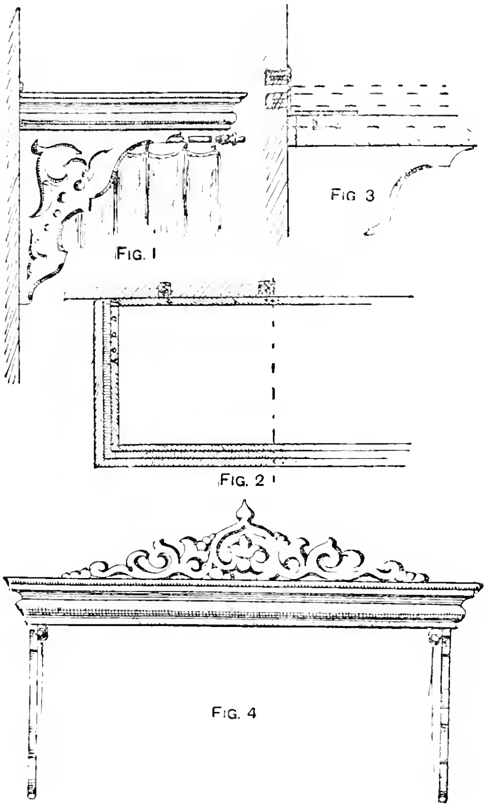


FIG. 1 FIG. 2 FIG. 3 FIG. 4

Fixing Wood Tester Head to Bedstead.

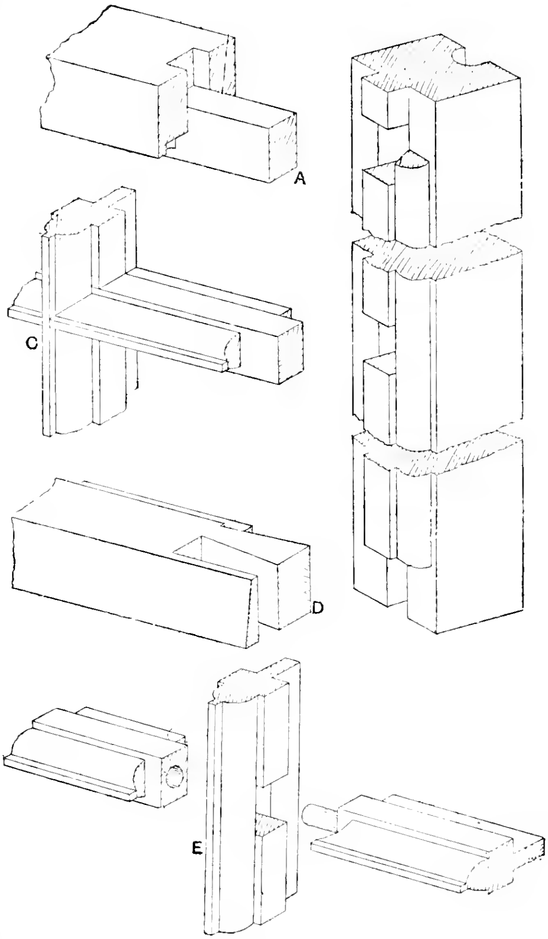
to shape as shown. Behind these brackets may be fixed a small brass rod, as shown, from which the curtains can hang. Or brass hooks may be used instead of the rod if the latter is considered too expensive. Fig. 4 shows the front elevation of the tester head, with a fretwork ornament in the centre of the top of the moulding. This will improve the appearance of the bed, but can be dispensed with. The top of the tester should be covered in with canvas or thin boards.

Making Copper Pan for Frying Fish. — Copper weighing 3 lb. to the square foot should be used in making a pan, say, 12 in. by 12 in. and 4 in. deep, for frying fish. The corners are usually brazed, but a "dog-eared" corner properly finished, with the top edges well up under the wire or flange, answers equally well.

Roach and Trout Fishing Pastes.—For egg paste for trout fishing, beat up an egg and add sufficient flour to form a stiff dough; then add a little cotton-wool worked well in if for running water. To make a good roach fishing paste, take a thick slice of fairly stale white bread, cut off the crust, and dip into clean water; then squeeze and knead till of the right consistency. Putting the bread into a piece of canvas before dipping into the water tends to keep the paste clean. A little cotton-wool may be worked in to prevent the paste being washed off the hook.

Cleaning Brown Kid Gloves.—To clean brown kid gloves, cut 1 oz. of white curd soap into small pieces, and boil with an equal weight of water till a smooth paste is formed, adding water to make up loss by evaporation; add 1 drachm each of strong ammonia and eau-de-javelle, stir well in, and allow to cool. The gloves should be stretched on wooden hands and well rubbed with the cleaning compound, then with a clean flannel, after which they should be allowed to dry.

Scribing and Fitting Sash Bars and Rails.—The sketches show how the several parts of a top sash are



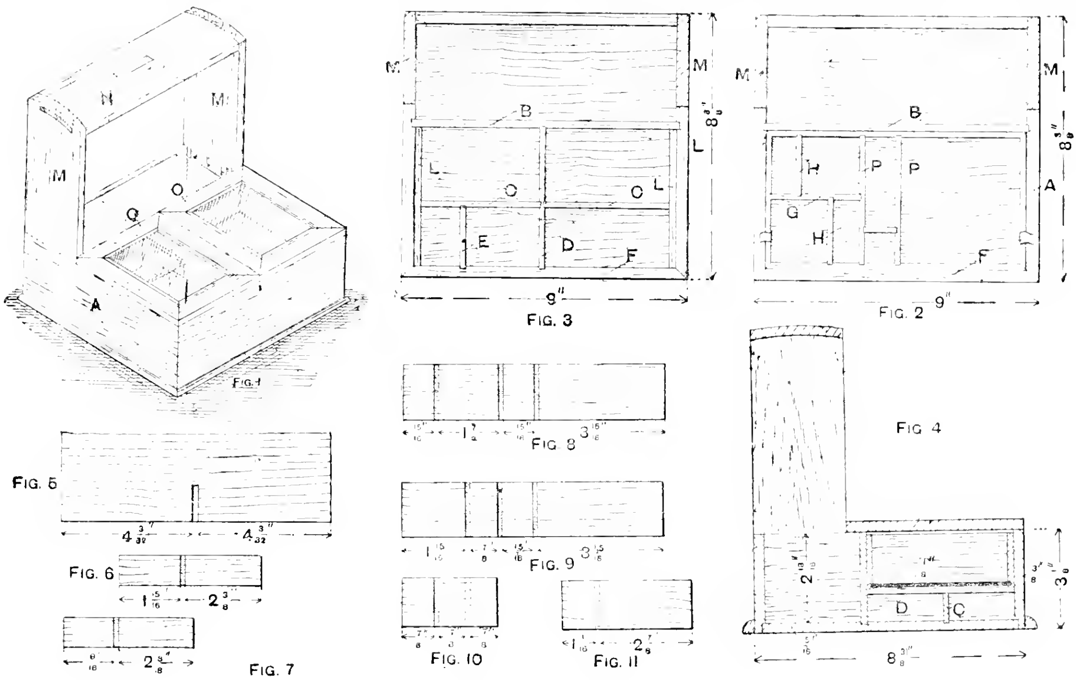
Scribing and Fitting Sash Bars and Rails.

formed with the mouldings scribed so as to fit together. At A in the above drawings is shown the tenon and mortise of top rail and stile, C is a joint between the bars, and D is a dovetailed joint between meeting rail and stile. At E is shown the joints between the bars, tenoned and scribed ready for fitting together. If desired, these joints can be made more secure by strengthening with dowels, as shown. The scribing should be done with a scribing gouge.

Hardening and Tempering Bicycle Cones.—If the bicycle bearings are of cast steel, they are hardened by heating to a cherry-red and instantly plunging into cold water or oil. They are then brightened with emery cloth and, to temper them, are carefully heated until they assume a medium straw colour. If left too light a colour they will probably chip. When made of Bessemer or mild steel and case-hardened, the cones do not require tempering.

Waterproofing Waggon Covers, Hatch Covers, and Coal Bags.—Willesden waterproof canvas is often used for waggon covers. Or No. 8 canvas may be dressed with a coat of raw oil 8 parts, and turps 1 part: when dry, paint with ochre or one of the earth pigments mixed as usual with boiled oil, turps, and a little patent driers. Hatch covers are made of a wider and cheaper canvas called tarpaulin canvas, and are dressed with Stockholm tar alone, which is applied warm with a brush. Coal bags are dressed with a mixture of Stockholm tar and linseed oil, applied while warm.

A Combined Jewel Box and Scent Cabinet.—Fig. 1 shows a cabinet constructed to contain jewellery in the front and at the back scent bottles which are fixed by contact with the lid. To lock the bottles, they must fit their sockets. The doors or lids of the cabinet are framed and glazed. Fig. 2 is a plan with the lids removed to expose part of the interior. The back of the box is joined to the front by a partition B, which is detailed in Fig. 5. The framework is of $\frac{3}{8}$-in. stuff, $3\frac{3}{4}$ in. wide, the sides being mitred together. Before fitting the parts together the grooves for the various partitions should be made. The groove for the partition B (Figs. 2 and 3) should be $4\frac{3}{4}$ in. from the front and $\frac{1}{8}$ in. deep, whilst for the pieces C (Fig. 3) the grooves should be $1\frac{3}{4}$ in. from the front, and only $\frac{1}{16}$ in. deep. Fig. 3 is a plan with the top tray removed. The front F (Figs. 2 and 3) has two grooves $\frac{1}{16}$ in. deep by $\frac{1}{16}$ in., one for D (Fig. 3), the other for E $1\frac{7}{8}$ in. from the left-hand end. These grooves run only $\frac{13}{16}$ in. from the bottom. The bottom must have a groove $\frac{1}{4}$ in. wide for B, and another $\frac{1}{16}$ in. wide for the rails C (see Fig. 4); at right angles are grooves for D and E. The fixing screws for the base are hidden by a moulding (see Fig. 4). The partition D (Figs. 3, 4, and 6) stands up $\frac{7}{8}$ in., allowing $\frac{1}{16}$ in. for the groove in the bottom. The left-hand cross rail C, with its $\frac{1}{16}$-in. groove, is shown separately in Fig. 7. The right-hand rail is without a groove (see Fig. 3). The top tray, shown in Fig. 2, is made from two pieces $8\frac{1}{4}$ in. long, $1\frac{3}{4}$ in. wide, and $\frac{4}{16}$ in thick, and two similar pieces $1\frac{7}{8}$ in. long. The bottom is $\frac{1}{8}$ in. thick, let in as shown in Fig. 1. The back strip, with grooves $\frac{1}{16}$ in. deep and $\frac{3}{16}$ in. wide, is shown separately in Fig. 8. The front (Fig. 9) is almost similar. The left-hand side of the tray should have a $\frac{3}{16}$-in. groove for the rail G (Fig. 2). The partitions may simply be nailed in from the bottom. Fig. 10 shows the short rail G, with two grooves $\frac{3}{16}$ in. wide, to take the short rails H (Fig. 2). The cross rails P (Fig. 2) are $1\frac{1}{4}$ in. long, $1\frac{3}{4}$ in. wide, and $\frac{3}{16}$ in. thick. The top tray rests on two rails L L (Fig. 3) $4\frac{3}{8}$ in. long and $\frac{4}{16}$ in. square, nailed to the sides. The two vertical pieces M (Figs. 1, 2, and 3) are $2\frac{7}{8}$ in. wide, $\frac{3}{8}$ in. thick, and $6\frac{1}{4}$ in. long. Pieces are cut away at the bottom of these, and also at the back of the side rails A (Fig. 2), similar to halving, so that these pieces can be fixed by screws from the inside. Or they may be dovetailed into the sides. The tops are curved (see Fig. 1), and the top rail N (Fig. 1) may be fixed at the ends by two tenons. The doors are mitred together, the framework being $\frac{3}{8}$ in. wide and $1\frac{1}{2}$ in. long for the top and bottom and $5\frac{1}{4}$ in. for the sides, whilst the thickness is $\frac{1}{4}$ in. The glass is let in in the usual manner. The doors are hinged to the sides. Under the two back pieces O O (Fig. 1) and near the centre are two small pins in the partition B (Figs. 2 and 3) to give the doors rigidity when locked from the front. The interior of the jewel tray should be covered with silk velvet, which in the case of the bottom part, or under the tray, should simply be fixed by means of a little thin glue. The appearance of the top tray would be greatly improved if the sides were padded with cotton wool or wadding. The two larger compartments to the left of the top tray (see Fig. 2) may each hold a watch, and a thin wedge-shaped piece with a hole in the centre should be glued in and covered. Fig. 11 is a detail of the right-hand partition P (Fig. 2). For removal of the top tray, fix two tabs or strings to the sides. Walnut, when polished, looks well as a wood for this cabinet.



A Combined Jewel Box and Scent Cabinet.

Re-polishing Birch Chairs.—Commence by dissolving $\frac{1}{4}$ lb. of common washing soda in 1 gal. of warm water, and cleanse the chairs with this; swill off with clean water, and wipe quite dry. Then apply with a camel-hair brush several coats of spirit varnish made as follows. Four ounces of best lemon shellac, 2 oz. of benzoin, 2 oz. of pale resin, and 1 pt. of methylated spirit; dissolve by frequent shakings and gentle heat; carefully strain through muslin. The varnish should be carefully applied, and an interval of at least half an hour allowed between each coat. Levelling the varnish on the most prominent parts (the seat and the back) is done by means of a polish rubber made fairly wet with polish glaze and spirit.

Making Cup Leathers for Pumps.—Proper moulding appliances are necessary for making the cup leathers of ordinary force and lift pumps. The iron or gunmetal moulds are the shape and size of the outside, and the stamp or core is of the size of the inside of the cup leather. The leather is cut circular and then soaked for a few hours in water or oil, accordingly as it is dressed or prepared, and then pressed into the mould by the stamp with considerable force. Temporary moulds and stamps can be made by turning them out of solid blocks of very hard wood, a lever being used for pressing one into the other, with the leather between them.

Fixing Slop Sinks.—A good slop sink should be made to hold rather more than a pailful of slops, for preventing an overflow if a house-flannel should get over the outlet. It should be made of impervious strong material, so as not to be easily broken by the fall of a scrubbing brush or other hard object into it. There should not be any corners in which filth can accumulate. The sink should have a flushing rim, and a flushing cistern attachment; the flushing pipe should be $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. in diameter. The basin should have a trap close beneath it, with cross-bars for keeping out anything that would choke it. The bars should be fixed, but easily removable for access to the trap for any purpose. As the rush of water down the waste-pipe violently expels the contained air, a ventilation pipe, not less in size than the waste-pipe, should be fixed. When fixed in private houses, the waste-pipes should be disconnected from the drains, the same as other sinks, but in hospitals and similar buildings they should be treated as soil pipes. Slop sinks down which hot water passes should not be connected to soil pipes. Hospital slop sinks require to be specially constructed with attached arrangements for cleansing bed pans with the least possible amount of handling.

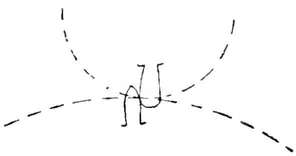
Boiling Water in a 5-gal. Tank. — Herewith is a sketch of an apparatus that will boil 5 gal. of water in a tank fixed 12 ft. from the fire. The tank should be made with an open top and be covered with a loose lid. If the tank is tightly closed at the top, a hole must be made or a pipe inserted in the covering for the escape of steam. In the illustration a four-pipe coil is shown in the fire, but if hot water is not required at a short notice two pipes will do—that is, the middle bend in the coil may be omitted. If the fire is moderately thick from front to back, the four-pipe coil will probably boil the 5 gal. of water in thirty minutes. A thin fire will be of little use in any case, as the comparatively cold coil will keep the fire dead. The pipes may be $\frac{3}{4}$ in. in diameter, but 1 in. will be better. The coil is only suitable for soft water. If the water is hard, a small boiler must be used instead of a coil, as the latter would quickly become choked with lime deposit. The boiler should be provided with a man-lid so that the deposit may be regularly removed. The tank can be supplied with cold water by a tap over the top or by a pipe connection in the side or bottom; this pipe should be fitted with a stopcock. It is essential that the pipes should have a rise from the coil to the tank of not less than 1 in. in 5 ft. The more the pipes rise the better.

Apparatus for Boiling Water in a 5-gal. Tank.

Mixing and Applying Floor Stains.—The practice of staining the margin left on the stairs at the side of the carpet and round the outer edge of a room carpeted with an art square has, from a sanitary point of view, much to commend it. A rich brown tone harmonises well with most carpets, but there is no apparent reason why other colours, as mahogany or pine, may not be used. A perfect match is not aimed at, as a good contrast does equally as well. To remove any dirt or grease, the floor should be well cleansed with warm water, in which has been dissolved a little common washing soda, not soap or powder. When quite dry, the floor is ready for the stain. Permanganate of potash will yield shades varying from light oak to dark walnut. One pennyworth dissolved in 1 qt. of water is about the quantity for a living-room or bedroom of ordinary size. When the stain is too light, apply a second coat, or add more potash. Best results are gained by two applications. Another simple plan is to use an ordinary walnut stain, say vandyke brown, mixed in a rather strong solution of common washing soda—one teacupful to 1 gal. of water; apply with a brush and rub well in with a rag, finishing off the long way of the boards. Brush-marks or a patchy appearance are thus avoided. If mahogany colour is desired, mix burnt sienna—which may be bought at paint stores ground in water—in equal parts of stale beer and water. For pine colour, use raw sienna; common malt vinegar is also useful to mix them with. For a rosewood colour, take 2 oz. extract of logwood, $\frac{1}{2}$ lb. red sanders; boil in 1 gal. of water for an hour. Strain through canvas or muslin, then add alum 1 oz.; apply hot. This imparts a reddish tone. To impart a darker tone, brush over again with logwood stain only; 2 oz. extract to 1 qt. If required still darker, or with dark streaks, add 2 oz. of blue or green copperas to the logwood solution. Floors thus stained should be afterwards brushed over with glue size, to prevent the varnish sinking in, and the nail-holes then filled up with putty coloured to match, then given two or three coats of spirit varnish, or a good quality oak varnish as used by house painters. When it is desired to stain and varnish a room in one day, a combined stain and varnish is used. Dissolve 4 oz. orange shellac in 1 pt. methylated spirits; then add as much dry brown umber or vandyke as will give the tone desired in at most two applications; apply evenly with a large camel-hair brush. It is well to bear in mind that where putty is used, it must always be used after stain size or a first coat of varnish; its oily nature prevents the stain, etc., striking into the wood and causing a patchy appearance. Spirit varnishes should be applied with camel-hair brushes, oak or oil varnish with hog-hair brushes. So that the varnished surface shall not be scratched, glue small pieces of washleather or cloth on the legs of the chairs.

Solder for Brazing Musical Instruments. — An easily fusible and smooth-flowing solder for brazing musical instruments consists of 6 parts of copper, 5 of zinc, and 3 of silver. The usual practice is to make the solder at the firms where it is used. Cast a small ingot of the alloy, and then roll this down to a suitable thickness. Strips are then cut of a convenient size for use when soldering.

Testing Correctness of Watch Depth.—To test the correctness of a watch depth, wedge the driven wheel tightly so that it cannot turn, then try the shake of the wheel teeth between the pinion leaves. If there is no shake, or if this is scarcely perceptible, the depth is too deep; if there is a lot, it is too shallow. In a correct depth the pitch circles of the wheel and pinion must roll upon each other. In the above figure the wheel teeth consist of radial lines to form the sides up to the pitch circle; beyond that they curve to a dome-shaped point.



Testing Correctness of Watch Depth.

Similarly, the pinion leaves consist of radial lines up to the pitch circle, and beyond that are finished off with a semicircle. In a correct depth the pitch circles roll upon each other, and the curved portions of the wheel teeth act upon the straight sides of the pinion leaves.

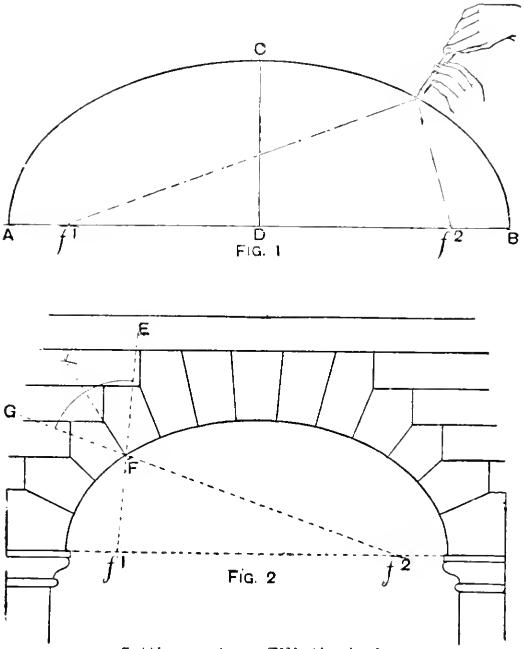
Refrigerating with Chemicals.—Chemicals may be employed for refrigerating purposes, but the really effective ones give a much lower temperature than freezing, and they are therefore not nearly so good as ice for the purpose. Equal parts of water, nitrate of ammonia, and carbonate of soda will yield a temperature about 35° below zero F. The cost of chemicals as refrigerators is, however, a great drawback to their use. After using them a solution is obtained which must be either evaporated to recover the salts or thrown away.

Heating Warehouse by Steam.—It is assumed that it is desired to heat by steam to 60° F. five workrooms, each 90 ft. by 33 ft. by 10 ft. Two 2-in. pipes each side of room would be equivalent to about 200 sup. ft. of heating surface, and this should be satisfactory with steam at low pressure. If the pressure exceeds 10 lb., less pipe would do, proportionately to the increase in pressure. With five rooms there would be 1,000 sup. ft. of radiation, and with low-pressure steam the supply main from boiler should be 3 in. The return is usually taken in pipe one size smaller, but a 2-in. pipe should be sufficient in this case. The size of trap cannot be given, but a trap made to work with 1,100 ft. to 1,200 ft. radiation should be used. The different makers' lists give the sizes. Expansion joints will be required in the 90-ft. runs of pipe.

Making Patterns for Small Columns.—In making a pattern for a small column, turn it to the required section, allowing $\frac{1}{8}$ in. per foot of length for contraction, all flanges having good drawing qualities to ensure clean castings. If the plinth is to be octagonal or hexagonal, turn it to the largest diameter, divide, and cut it to the required number of sides. If it is impossible to make a core-box on account of the core being too long for sand, a spindle must be used to turn the core, with a core-board, which is made of $\frac{3}{4}$-in. or 1-in. stuff with a bevelled edge. It is fixed to the core-maker's spindle-bench and turned with a handle. The sand is applied to a spindle, which is kept for that purpose.

Disinfecting a Water-butt.—If soft water in a butt smells, the latter should be emptied, turned on its open end, supported on one side so as to leave an opening, and some sulphur should be placed on an old saucer, fired with a red-hot iron, and placed underneath the cask. The fumes from the burning sulphur will disinfect the cask. Before putting the butt into use again, slake some lime and give a thick coat over the inside; from time to time relime the butt.

Method of Setting out an Elliptic Arch. In commencing to set out and turn an elliptic arch, the ellipse must first be set out by drawing a line A B (see Fig. 1) equal to span of arch. Through centre of line raise a perpendicular C D equal to required height of arch (say ⅓). The foci of the ellipse are found by taking C as centre and the distance A D as radius, and describing an arc to cut A B at f f^2. The semi-ellipse may then be drawn by taking a piece of string equal in length to A B and fixing it by pins at f^1 and f^2. Insert a pencil into the loop thus formed and draw the curve as at Fig. 1, taking care to keep the thread perfectly tight. To set out the stones forming the arch, divide the curve of the ellipse into the required number of equal parts (Fig. 2), and through each point draw lines from each of the foci, as at F. Bisect the angle E F G. The line which bisects the angle is a perpendicular to the curve. An arch constructed by this method will require every brick or stone to be of different shape in half the arch.

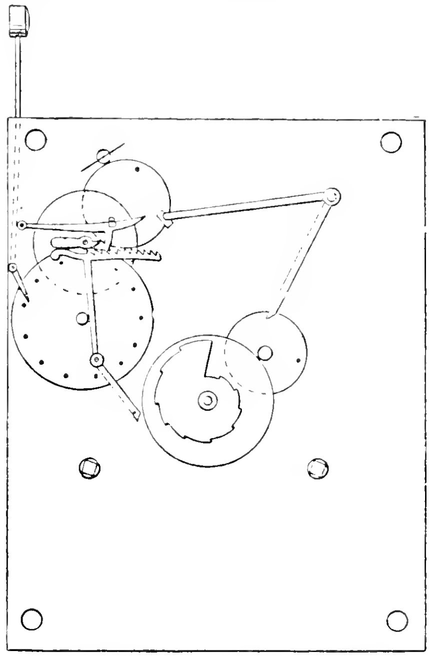


Setting out an Elliptic Arch.

Straightening a Warped Oak Panel.—To straighten a thin oak panel that has much twisted since the polish was applied, place it face downwards, under pressure, with several thicknesses of paper intervening to protect the polish. If cramps are not available, on the workbench screw pieces of wood which will well overlap the corners. Slack out the screws. Give the back of the panel several coats of spirit varnish or polish. Apply liberally with a brush, taking care that the polish does not run over the edges and spread underneath. Whilst still wet, apply pressure by tightening the screws, which should be fairly strong. Repeat the operation if necessary, and secure the panel in its place, when straight, by nailing strips of wood around its outer edges.

Producing Blue Photographs.—Blue prints may be made by brushing over any fairly pure paper with equal quantities of (*a*) citrate of iron and ammonia 1 part, water 4 parts; and (*b*) potassium ferricyanide 1 part, water 4 parts; these are printed in usual way. Or the first solution may be used alone, and the second solution applied as a developer after exposure. A blue-green image on a brownish ground is produced, but the brown washes away in clean water, leaving the image fixed. It is advisable, however, to give the prints a citric acid bath, 1 in 40. Paper for this ferro-prussiate process, as it is called, may be obtained ready for use of any photographic dealer in packets each containing twenty-five half-plate pieces. Blue pictures may be made by the carbon process, which is the most satisfactory and permanent process to employ; the tissue (or sensitive paper) may be obtained in any desired colour. The paper, which appears to be almost black, is exposed as usual, but does not print a visible image. It may be timed by an actinometer or by another negative of the same density printing on P.O.P. It is next squeegeed into close contact with a paper coated with insoluble gelatine and placed in hot water. The parts unaffected by light dissolve away after the top paper has been stripped off, leaving the image in pigmented gelatine on a white or other ground. The print then merely requires immersion in alum, and slight washing to remove the bichromate.

Defective Striking Gear of Grandfather Clock.—The incessant striking of a grandfather clock until the motive power is exhausted may be due to one of these causes. The rack hook B (see sketch) may stick; or the rack tail being bent may come in front of the hour snail, and thus allow the rack to fall too far for the gathering pallet to touch it; or the pin in the end of the rack to catch the gathering pallet may be missing.



Striking Work of Grandfather Clock.

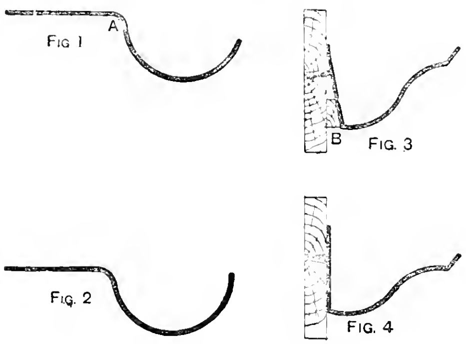
Powdering Soap.—The only means of powdering a pure soap is to dry it as much as possible and then to put it through a machine that will act like a rasp. For small quantities, a sugar grater would serve the purpose. Dry soaps are combined with soda ash, which renders them much easier to powder.

Effect of Form of Orifice on Velocity of Efflux from a Pipe.—It is required to know the effect of the form of the orifice from which a liquid is flowing on the velocity of the efflux. With an orifice of the same diameter as the pipe, the liquid escapes at the same speed as that at which it travels in the pipe. If the orifice is contracted, the same quantity has to pass through the smaller aperture, and to do this the speed must increase so that it issues with greater force, and, if pointed vertically, would be driven to a greater height. On the other hand, if the orifice is increased as a trumpet, the speed of the issuing water is lowered at the point where it enters the open air, and the water will not rise to such a great height, but will be broken into spray by the resistance of the air acting on a larger surface. A trumpet-mouth orifice is used only when it is desired that the issuing liquid shall spread, and a jet orifice is used when the water is to be forced a considerable distance, as illustrated by some kinds of fountains and also by the hose jets used for extinguishing fires in buildings, etc.

Making Ammonia Soap. — A recipe for making ammonia soap is the following. Take 100 parts of oil and fat, 10 parts of caustic potash, 8 parts of caustic soda, and 5 parts of strong ammonia. The amount of water and the strength of the lyes will depend on the process employed; it will not be satisfactory to make the soap by the cold process and boil it afterwards unless making simply a soap jelly. For the cold process the lye is at 65° Twaddell, and about 40 lb. of water would be required, but for boiling add more water; the ammonia must be added after the soap has cooled somewhat.

Effect of Bends in Pipes.—Liquids flow in straight lines through straight pipes, those in the centre travelling at a higher speed than those in contact with and rubbing against the insides of the pipes. On turning a bend, the straight lines deviate in proportion to the angle of the bend, and those on the outside of the current cannot keep their relative positions unless they travel at a higher speed. The lines thus become changed, and the friction between themselves, and also their tendency to maintain a straight course inside the pipe, causes a retardation in the velocity, so that a lesser quantity passes through.

Badly Fixed Cast-iron Gutter.—Cast-iron gutters sometimes droop forward so much that water splashes over. The cause has to be ascertained and remedied. If the gutter is of half-round pattern, it is probably fixed with brackets, screwed on underneath the soffit, and the front of the gutter has fallen because the brackets were originally too weak to support it, or they have subsequently become too weak, owing to rust. The brackets will then be found to have given way at A (Fig. 1). The remedy is to remove the brackets, and either to bend them upwards until they assume the shape shown in Fig. 2 or to have new ones made according to this improved shape. If the gutter is of ogee shape, and is fixed by screwing on to a fascia board, the falling front may be due to the back of the gutter having been cast too much on the bevel with the top, as shown in Fig. 4. The remedy is to fix a strip of wood along the fascia, for the bottom edge of the gutter to rest against, as shown at B (Fig. 3). If neither the brackets nor the shape of the gutter is at fault, it is possible that dry or wet rot in the soffit or the fascia has lessened the holding power of the screws. In such case the remedy is to fix new boards.



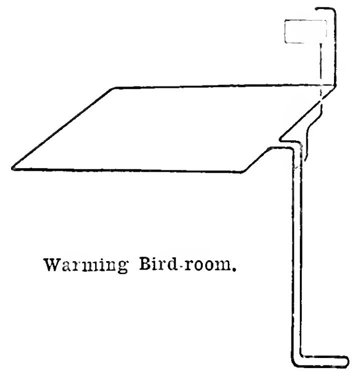
Fixing Cast-iron Gutters.

Old Method of Casting Lead Water-pipes. — At one time all small lead pipes up to 2 in. diameter were cast in an appliance known as a "stalling and burning machine." This consisted of an iron core, or mandril, of the same size as the bore of the intended pipe, with one end attached to a flange or base, and an outside iron mould, constructed in two halves, and held together by clamps placed round the core, with an annular space between equal to the thickness of the pipe. The mould and core being stood on end, molten lead was poured into it; the mould was then removed, the piece of pipe drawn upwards nearly off the core, the mould then replaced, and more molten lead poured in, the pouring being continued until the bottom end of the previously made pipe was fused, and thus joined to the last one. An appliance of the kind has been in use since 1639, probably before.

Kitchen Boiler Tap and Joint Leaking. — To remedy a leak at a boiler joint, take out the tap and put a new grummet or washer between the back nut and the boiler. To move the nut, it must be held by a large screw-hammer or spanner inside the boiler, while a similar tool must be used to turn round the tap outside. The new washer can be made of sheet rubber, or some yarn twisted into a ring, or a ring of cardboard soaked in water to make it soft. With the two latter red- and white-lead (mixed to the consistency of very soft putty) must be used. A leak at the bottom nut of a boiler tap most probably indicates that the plug is worn and wants "re-grinding." Unscrew the nut and take out the plug. Then replace the plug, with a little flour emery and oil smeared on it, and twist it round and round evenly to grind the surfaces true to one another. To make a successful job, however, the grinding should be done in a lathe.

Preserving Butter.—To preserve fresh butter, well press it and incorporate with it some salt; work out most of the water by kneading, then press into clean jars, fasten parchment paper over them, and keep in a cold cellar. Butter thus prepared will keep for several months. Fresh butter, if properly prepared and free from excess of water, will usually keep for a long time. Preservatives are sometimes added, but they are more or less harmful; borax is perhaps the least objectionable, and is added in quantities of 2 grains to 5 grains per lb.

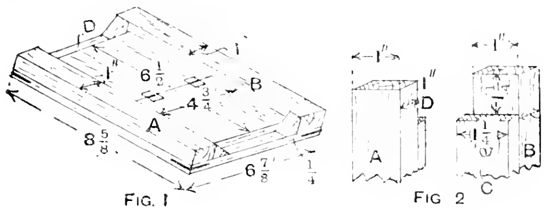
Warming Bird-room.—A number of canaries are kept in an upper room, and it is assumed that a method of heating it during the winter months is required. The accompanying illustration shows a method of heating it by a coil dropped in a fireplace. There is every probability that one 2-in. pipe round will suffice; or, if the room be small, a 1½-in. pipe may do, supposing that a temperature of 55° will be sufficient when the temperature outside is below freezing point. The coil in the fireplace (somewhere below) can be of 1-in. pipe, and this size of pipe will do from the coil to the room. Most probably a pair of pipes in the fire will do as shown, but this depends on the size of room and the pipe in it. The fire pipes (scarcely a coil) should be in a sitting-room grate, not in the kitchen range; then the coil gets attention regularly according to the weather, and there need be no stopcocks or controlling device. If the fire has small fuel put on it at night, it will keep alight better than the kitchen fire will. A small cistern will be required for feeding the apparatus, as shown. This can be replenished by hand. There must also be a steam pipe on the highest point of the piping in the room. All circulating pipes ascend from the coil to this steam pipe at least 1 in. in 10 ft.; the pipes must not run quite horizontally.


Warming Bird-room.

Polishing Limestone Fossils.—If the fossils are in section or have a flat surface, rub them down with fine sand and water on a smooth stone until the face is level. Wash away the sand and rub them on a wet stone until the scratches are all removed and the fossils appear quite smooth, but dull. Now rub them on a smooth piece of wood or glass, using dry crocus or rouge, and, when a dull polish is gained, finish on a piece of felt with dry putty powder. If the fossils are not flat the rubbing must be done with cloths, using the materials as above described.

Staining Matchboarding to Imitate Pine.—To stain matchboarding to imitate pine, procure some raw and burnt sienna, ground in water; the former gives the yellow tone of pine. Mix as much of this as is required in equal parts of stale beer and water. Apply with a brush, rub well in, and finish off in the direction of the grain with rag. When dry, it may be brushed over with patent size to prevent the varnish sinking. After both stain and size are dry, fill up nail holes, etc., with putty coloured to match. To finish, use ordinary spirit varnish or oil varnish.

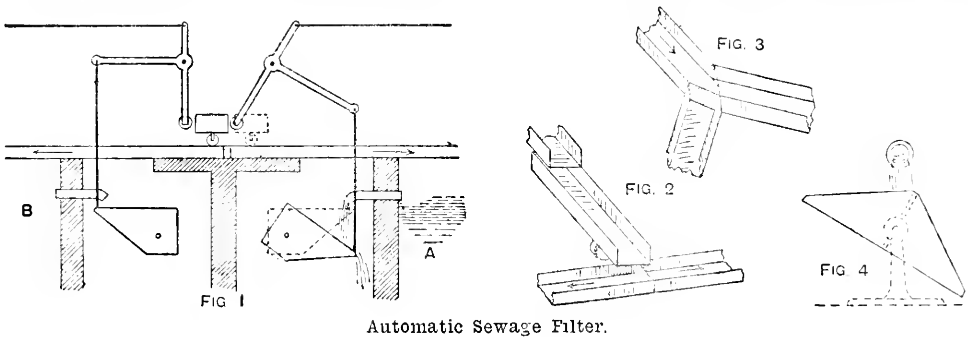
How to Make a Half-plate Printing Frame.—To make a half-plate printing frame, first mitre four pieces of ¾-in. stuff (any well-seasoned wood will do), two pieces 8⅝ in. by 1¼ in., and two pieces 6⅞ in. by 1¼ in., and join with a strip of veneer at the four corners. Glue across two blocks A and B 8⅝ in. by 1 in. by 1 in. Two blocks 1 in. square should be sawn across diagonally and glued flush into the four corners to form stops for the negative. The frame will now have a sight of 6½ in. by 4¾ in. and a rebate of 6⅝ in. by 4⅞ in. Out of ½-in. stuff cut a piece 6½ in. by 4⅞ in. Plane it up flat and halve it the short way of the stuff. On one side of each



How to Make a Half-plate Printing Frame.

slab a piece of velveteen should be glued and the slabs hinged together. The fold-over spring is the better form, the print not being so liable to slip. When mitring is not possible, two pieces 6 in. long may be glued to A and B, thus leaving a space for gluing over C and D (see Fig. 2). This may be further strengthened by screws, but the frame will not bear so much rough usage. It is essential that the frame should be free from twist, or the negative will be broken.

Automatic Sewage Filter.—Automatic arrangements for opening and shutting the valves of a sewage filter are only to be trusted where a small quantity of sewage is to be dealt with. Fig. 1 illustrates a mode of filling and emptying two filters automatically by means of tippers connected by bell-cranks to the trough which brings down the liquid to be filtered. Filter A, on the right, is supposed to be filled up to the level of the overflow, when the liquid, escaping into the tipper, pulls down the bell-crank, and pushes over the sewage trough to such a position that the flow of sewage is diverted into filter B. At the same

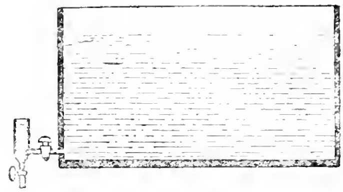


Automatic Sewage Filter.

time the outlet valve of filter A is opened by means of the wire attached to the top of the bell-crank. The supply trough is pivoted at one end, and is carried at the other end on a roller, so as to move easily; the arrangement is shown in Fig. 2. Instead of having a movable trough, the arrangement shown in Fig. 3 may be used, where a movable division can be turned over so as to divert the liquid into either channel as required. Fig. 4 is a well-known form of tipper for discharging alternately to the right or left, but with this both filters would be worked at the same time, instead of alternately, as in the first arrangement.

Painting Photographic Backgrounds.—Mix with water to the consistency of ordinary paint, lampblack, whiting, and a little ultramarine with size to bind the ingredients. Endeavour to produce a good neutral tint. To obtain a shaded effect, use a large brush and work as quickly as possible, lightening the tint as the work proceeds. If the shading is done while the work is wet the shadows blend well together, and all hard lines are prevented. Some workers hatch over the background and afterwards put in clouds with a blunt charcoal point. It has also been proposed to mix the colours very thin, and apply them with a watering pot. So long as the masses of light and shade and the perspective are correct, and objects are not too distinct, the painting need not be very carefully done. Paper backgrounds may be purchased very cheaply, so that unless some special design is required it is cheaper to buy the ready-made article.

Measuring Liquid from Tank.—There are several ways of measuring liquids from a tank. If the amount of liquid is large, a wood, brass, or iron rule may be placed either at the centre or at the side of the tank.



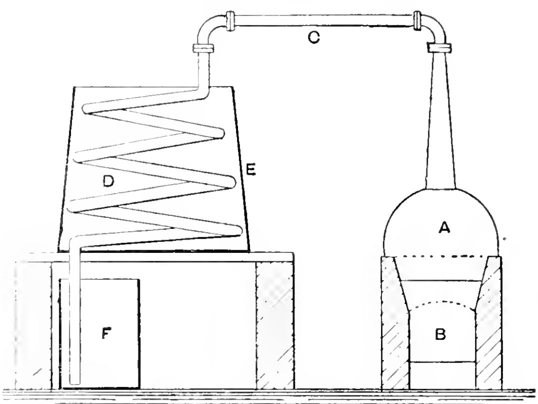
Measuring Liquid from Tank.

If the quantity is small, then a sheet brass, copper, or glass cylinder may be fixed to the tank by means of a small pipe as shown. A stopcock should be attached to the pipe from the tank, so as to regulate the flow of liquid into the measuring cylinder, and also a stopcock at the lower end of the measuring cylinder so that the liquid may be run off.

Removing Ink Stains.—To remove from parchment or paper stains made with ordinary writing ink, apply spirit of salts (hydrochloric acid) diluted with five or six times its bulk of water. Solutions of either oxalic, citric, or tartaric acids are said to produce the same results; but in any case the acid must be washed off with clean water a minute or two after application. Experiment on odd pieces of parchment or paper before touching any valuable work, as some little skill is required. To remove ink stains from imitation ivory, wipe over several times with 1 oz. of oxalic acid dissolved in ½ pt. of hot water. Should this be of no avail, rub the surface with fine glasspaper till all marks are removed; then repolish with putty powder and oil, applied with felt or cloth; finish with dry powder and chamois leather. A solution of ¼ oz. of citric acid in 4 oz. of water will remove all traces of writing ink from paper. This does not touch printers' ink, which indeed cannot be removed by the mere application of a bleaching agent. To remove ink or ironmould stains from linen, moisten the latter by holding it in steam, then apply weak hydrochloric acid on a piece of stick. When the stain is dissolved out, wash the article well to remove all acid. To remove old ink stains from wood, rub the stains with muriatic acid, allowing the acid to remain for a few minutes; then sponge off with clean water. Spirit of salts may be used to remove old ink stains from wood; great care is required, especially if the stains are on a veneer. Another method is to apply spirit of nitre with a feather, and when the ink has disappeared to wash off with cold water. Another; use salt of lemons (binoxalate of potassa) moistened with water. Another; put some powdered crystals of oxalic acid on the ink stains, moisten with hot water, and rub them in. The oxalic acid will dissolve most of the otherwise insoluble ingredients of the ink, and the stain can be washed out with water. If this is not effective, try a solution of freshly made chloride of lime.

Upholstering a Chair Seat.—The following are instructions on upholstering the seat of a crown-back parlour chair. These chairs are usually made with a loose seat frame, fastened together with dowels and upholstered on the top; the edges are not stitched, the flocks being strung on the edges with twine, this being tacked fast about every 4 in. to the top of the seat frame and then filled up with flocks. To make these chairs into spring seats, put a stuffing rail, 2 in. high, on the front and sides, web the bottom with four lines of chair webbing, stitch three chair springs to the web in the form of a triangle, the odd spring at the back. Cover the top over the springs with hessian and stitch the springs fast in an upright position. Pick on a layer of flocks and put on another cover of hessian; commence tacking in the centre of the chair front and work round to the back. Stay-tack the back, blind-stitch the front and sides, then stitch up the edge to a fine point with three rows of stitches. Pull out the stay-tacks, fill up hollow places with stuffing, pull the cover down as tight as possible, and secure; clean off the edges with a sharp knife; the stitching up makes no difference to the sweeps and curves, these being allowed for in tacking on the covers, letting out or taking up as may be necessary.

Distilling Whisky.—The process of distilling whisky is very briefly as follows. A mash, made from malt and barley or other material, is fermented with yeast, and after skimming is run into stills to separate it from the water and other products. Several forms of stills are used for distilling whisky; many of them are heated by open fires, imparting a smoky flavour to the spirit (like Scotch whisky); these are known as "pot" stills, and the whisky is called "pot" still whisky. Other forms of stills are heated by steam, the object being to distil off the spirit as strong as possible and to keep the water in the still. The sketch above shows a simple form of "pot" still. A is the still proper; B is the fireplace for heating; C is the connecting pipe to the worm D; E is a large vessel or condenser filled with cold water, into which cold water runs continually and is syphoned away again; and F is the receiver for the distilled spirit. The spirit obtained from the first still is usually weak, and is re-distilled twice, more water being removed each time; the product of the third distillation is whisky, which is stored in vats for a long period to mature it and improve its flavour.



Apparatus for Distilling Whisky.

Particulars of Copper Ores.—Native copper—that is, pure copper—is found in veins disseminated in granite in Cornwall and North Wales; but the most abundant English ore of copper is copper pyrites or yellow copper ore, which is a double sulphide containing copper, iron, and sulphur, and is generally associated with arsenical iron pyrites, tinstone, quartz, fluorspar, and clay. A purer variety of pyrites is peacock ore, or variegated copper ore, which is found at St. Austell and Killarney. Another abundant ore is grey copper ore, which is a compound of the sulphides of copper and iron with those of antimony and arsenic; but it often contains lead, zinc, and sufficient silver to render the extraction of the latter a matter of great importance. Copper glance is another important Cornish ore; it is a chemical compound of copper and sulphur, and is generally free from other metals. Red copper ore consists of copper and oxygen, and differs from the preceding ores in being free from sulphur; green malachite, which is not much found in England, is a basic carbonate of copper. These are all English ores, but Great Britain also imports copper sand, a mixture of metallic copper and quartz; and indigo copper, so named from its dark blue colour, from Chili; and blue malachite from Australia. The following table shows the proportion of copper in the ores above named:—

Ore.	*Composition.*	*Copper in 100 parts of pure ore.*
Red copper ore	copper, oxygen	89
Copper glance	copper, sulphur	80
Indigo copper	copper, sulphur	97
Copper pyrites	copper, iron, sulphur ...	32 to 35
Peacock ore	copper, iron, sulphur	55
Grey copper ore	copper, iron, sulphur, antimony, arsenic	25 to 40
Green malachite	copper, oxygen, carbonic acid, water	... 58
Blue malachite	copper, oxygen, carbonic acid, water	... 56

Retaining Wall for Sunk Roadway.—Probably the best form of retaining wall in brick for a sunk roadway 40 ft. wide and about 40 ft. below the level of the land at each side would be a series of relieving arches on piers in four tiers as shown in Figs. 1 and 2. The front is filled in by a screen wall, giving the whole the appearance of a solid wall, although really the length of the archways is such as to prevent the mass of earth resting against it. To compute the length of arch required, Rankine's formula gives a sufficiently approximate result; $l = \text{cotan. R}\left(h + \frac{x}{(1 + \sin.\ \text{R})^2}\right)$; where l = the length, h the clear height of each tier, x the depth of the crown of an arch below the surface, and R the angle of repose of earth, which may be taken at 45°. Calculating first the lowest tier, cotan. R = cotan. 45° = 1; h = 10 ft.; x = 30 ft.; and sin. R = sin. 45° = ·7071. $\therefore\ l = 1\left(10 + \frac{30}{1{\cdot}7071^2}\right) = 20{\cdot}2$ ft. In the second tier, x will equal 20 ft. and l = 16·8 ft. In the third tier, x = 10 ft. and l = 13·4 ft. In the top tier, x is zero and l = 10 ft. Fig. 1 gives a vertical section of the wall, and Fig. 2 an elevation with the arches indicated. Retaining walls of such a height as this are exceedingly costly to erect, and unless the land at each side is of great value, the cheapest method of dealing with this case will be to buy a strip of land at each side of the road and cut away the earth until there is a slope of 1 in $1\frac{1}{2}$.

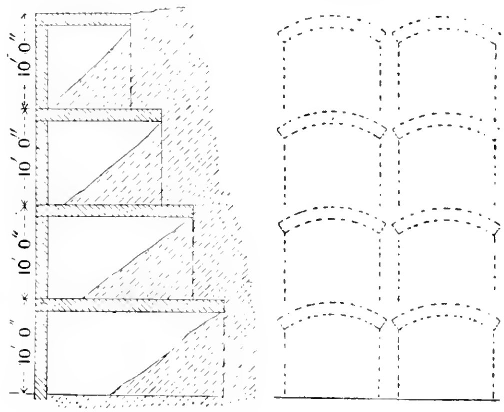


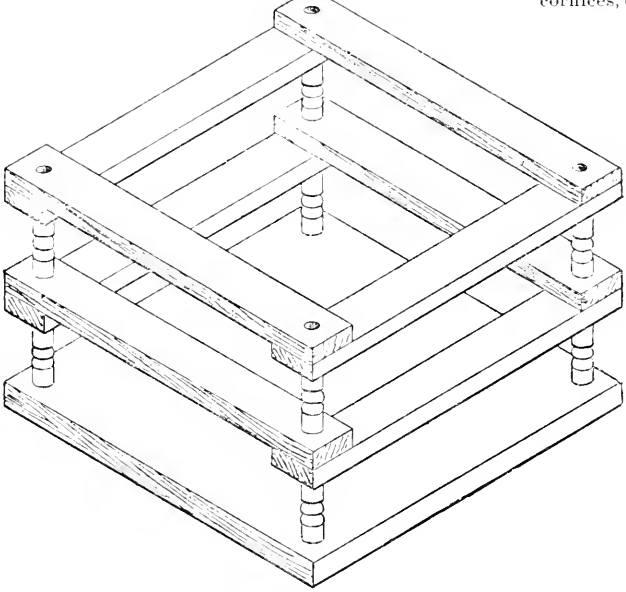
Fig. 1 Fig. 2

Retaining Wall for Sunk Roadway.

Colouring Bottom of Swimming Bath.—It is required to colour the concrete bottom of a sea-water swimming bath so that the bottom can be plainly seen by the swimmer. A Portland cement known as "white cement" might be light enough in colour for the finishing coat without any further mixture. Or limestone chippings, pulverised very finely, may be mixed in the finishing coat, and a skin can be made in this way which is almost milk white. White enamelled bricks would make a much better job, but expense may prevent their use. In any case, occasional strips of colour, running along the length of the bath, should be formed in the bottom by colouring the cement with Venetian red or red ochre. This colouring is useful as a guide to swimmers when swimming under water.

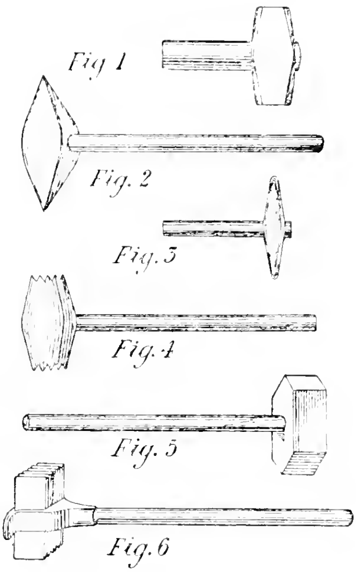
Paste for Attaching Cloth to Carriage Frames.—This is a recipe for a paste for fastening cloth on the frames of carriages. It is known as coach trimmers' paste. Mix rye flour with cold water to a creamy thickness, and add a good proportion of powdered resin; then boil very slowly, continually stirring until the mixture is fairly thick. When cold the paste should be firm enough to cut with a knife, so that it can be spread on the cloth.

Making and Hanging a Baby's Swing.—The sketch of a baby's swing here given is almost self-explanatory. The seat of the swing is made from beech, say 1 in. thick and 15 in. by 15 in., with a hole ½ in. through each corner. Four ropes are passed through these holes, and stopped by knots underneath. The other ends are spliced or tied, two to each upper rope. Eight wooden spindles, bored from end to end with ½-in. holes to allow the lower ropes to slide through, are passed on as shown. Eight cross-bars, bored near the ends with ½-in. holes, and strung on—four between the two sets of spindles and four above them—will complete the swing. The cross-bars and spindles must be of beech, oak, or other hard wood, or they will be apt to split and lead to accident. The cross-bars can be 2 in. by ¾ in. by 15 in., and the spindles 1 in. diameter and 3 in. long. If the seat-guard is not considered deep enough, add four more spindles and four more cross-bars. Knots can be made above the seat-guard to keep the cross-pieces and spindles in place, if desired; but that is not usual, as the child's weight prevents slipping. The four lower ropes should join the two upper ones about 12 in. above the top of the seat-guard. Two places are found in the ceiling so that when hooks are screwed in they will enter the wood of the joists, and not merely hold by the plaster or the lathing. By driving a knitting needle into the ceiling, the position of the joists can be found without much damage. The ropes must be hung by metal eyelets held in spliced loops.



Making and Hanging a Baby's Swing.

Facework on Granite.—"Granite is dressed," states "Builders' Work and the Building Trades," "by means of heavy picks and axes, after having been roughly shaped with the scabbling hammer. Mouldings, rebates, etc., are cut by means of iron chisels, steeled at the cutting edges, and used with a small hand hammer, called a mash hammer (Fig. 1). Granite, grit, and other hard stones, built into walls with their faces merely scabbled, are said to be quarry-pitched, hammer-faced, or hammer-blocked. Such work is called rock or rustic work, and is mostly confined to foundations, plinths, and quoins, where a bold massive appearance is aimed at. The following are the different kinds of work put on granite in Aberdeen; other hard stones are dressed in a somewhat similar manner. Hammer-faced, hammer-dressed, or hammer-blocked work is done with the scabbling or spalling hammer. Thus squared stones for the quoins or face of a wall, merely left rough from the hammer, would be termed hammer-faced ashlars; the term ashlar in such a case being taken to mean square blocks 12 in. deep on face and upwards, squared stones under 12 in. deep being called shoddies. Scabbled or roughly picked with a pick, such as in Fig. 2, sometimes called a scabbling pick, and weighing about 20 lb., which takes down the excessive irregularities on hammer-faced work. Punched or puncheoned, or worked to a finer face with a blunt pick (Fig. 3) called a punch or puncheon. Picked, or brought to a finer face with the pick shown in Fig. 2. Close or finely picked, dabbed or daubbed, done with a fine-pointed pick, or with a serrated pick, as in Fig. 4, leaving a surface as smooth as the process will admit of. It is usual to run a draught, or smooth surface, 1 in. or more in breadth, round the margins of squared stones, even when dressed only with the hammer or pick, in order to ensure close-fitting joints. The stones are then said to be hammer-faced or, as the case may be, with draughted margins. These margins are wrought with the axe as in single and fine axing. In single axed work the inequalities left by the pick are reduced by an axe weighing about 9 lb. (Fig. 5). Axed work shows the mark of the tool in parallel lines, and is used in quoins, rebates, cornices, etc. Fine axed is a more careful description of single-axed work. Patent axed is the finest description of surface-work before polishing, and is produced with a hammer or axe the faces of which are formed of a number of parallel thin steel blades bound together, so as to allow of their being taken out and re-sharpened (Fig. 6). Polished work is performed by rubbing, first with fine sand and water under an iron rubber, then with emery, and lastly with putty and flannel. All plain surfaces and running mouldings can be done by machinery, but carvings and broken surfaces have to be done by hand. Hard stones, such as granite, show off to best advantage when polished; but if such a high finish is considered too costly, it is better not to waste money on too fine a face, which only destroys the beauty of the grain, and produces a flat, monotonous surface." In the accompanying illustrations Fig. 1 is a mash hammer; Fig. 2, scabbling pick; Fig. 3, punch; Fig. 4, serrated pick; Fig. 5, axe for single-axed work; Fig. 6, axe for patent-axed work.

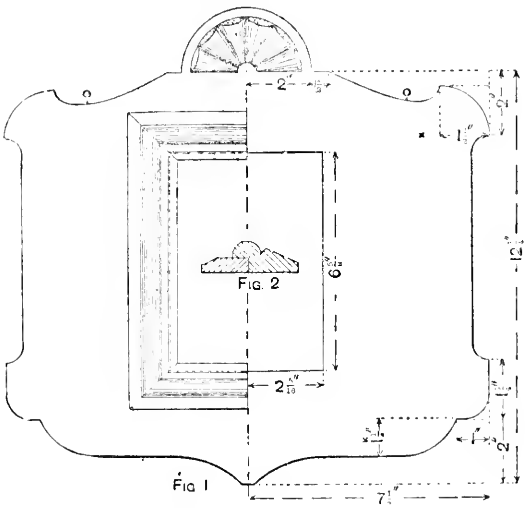


Tools for Dressing Granite.

Making Birdlime.—Proper birdlime is made from the inner bark of the holly, which is taken in the summer. This is boiled with water for several hours until quite soft; the water is then drained off and the pulp placed in a covered pit and left for several weeks to ferment. It is then pounded in a mortar and kneaded with the hands and kept under water till required. Spurious birdlime may be made by boiling linseed oil until it becomes sticky; this will take many hours. Another preparation is composed of boiled linseed oil 3 oz., gum thus or Venice turpentine 1 oz., and castor oil 1 oz.

Stickiness of Oilskins.—The stickiness of an oilskin coat which has been dressed with a mixture of boiled oil, terebine, and oil varnish may be due to the use of inferior materials, though it must be remembered that mixtures do not always dry quickly. Boiled oil, oil varnish, and terebine are rapid driers, and when excessive amounts of driers are present the mixture hardens rapidly on the surface and but slowly throughout, the film remaining tacky for a long time. The mixture should dry right through equally, and therefore not too rapidly. Boiled oil alone is a good preparation, but a little gold size may be added if desired to make it dry more rapidly. The oil should be applied in a thin coat, the oilskin hung up in a warm place till quite dry, and a second coat applied and also allowed to dry. As it is doubtful whether it is possible to get rid of the stickiness, it is perhaps better to steep the oilskin in benzoline for a time, dry it in the open air, and treat it as above.

Making a Brush Rack.—In making the brush rack shown in Fig. 1, a piece of oak, walnut, or mahogany about ⅜ in. thick and a little larger than the dimensions shown may be used. In setting out, commence with the middle line; then draw in the outline; and, lastly, fill in details. The small curves can be worked by the brace and bit. If preferred, the semicircle on top can be worked separately and glued on. The opening in the centre is for a mirror measuring $6\frac{1}{2}$ in. by $4\frac{1}{2}$ in. The



Design for a Brush Rack.

gilt slip overlaps the hole about ¼ in., and the moulding overlaps the outside edge of the gilt slip about ¼ in. (see Fig. 2). If this cannot be managed neatly, substitute a piece of plain moulding without a rebate. Large brass hooks should be screwed in the positions shown by the crosses. The hooks underneath the glass may hold a small hat brush.

Removing Stains from Engravings.—Mere age stains can be removed from engravings by placing the latter in a shallow tray (a tea-tray, for instance) containing water, and exposing them to the rays of the sun till bleached, when they should be allowed to dry naturally. When dry they can be ironed with a hot iron over several folds of linen to take out all creases, etc. To remove yellow grease stains, lay a sheet of muslin in a tea-tray, and on the sheet lay the engraving. Take the whole into the open air and with a soft wash-leather pad well sponge the yellow stain with petroleum spirit or spirit of wine. Do not in any case attempt to do this indoors or near artificial light, as the spirit is highly inflammable. When the stain has been removed, lift the muslin and engraving together from the dish to a table, and cover the face with blotting-paper, placing over this a sheet of brown paper, and then a sheet of calico. This done, turn the whole over, remove the muslin back, replace with blotting paper, brown paper, and calico, and submit the whole to gentle pressure until dry. Stains caused by damp, etc., are removed by the following method. Cover the engraving in a glazed earthenware tray with clean rain-water till the paper is saturated; then pour off the water, and substitute a solution of chloride of lime strained through muslin. The moment the stain disappears pour the solution away, and rinse the engraving in clean water. Then dry, and ensure smoothness by stretching the paper. To remove grease stains, lay the engraving between several folds of clean blotting-paper, and pass a hot iron over it. Continually change the paper and repeat the ironing. Several applications of benzine are also effective in removing grease. Damp and age stains may be removed in the following manner. Lay the engraving in a flat dish—a sheet of glass with wooden sides dressed with paraffin wax will answer very well—and pour over it a mixture of equal parts of benzoin and concentrated solution of chloride of lime and water. Let the engraving remain till the stains disappear; pour off the bleach, and well wash with cold water as the engraving lies in the dish. On no account attempt to take it out. After a dozen or so changes of water, let it soak for an hour in fresh water; tip up the dish, and let the engraving dry on the glass. Very slight friction with a camel-hair brush may be applied to a particularly obstinate mark, but do not finger the paper while it is wet.

Making a Wooden Washing Tray.—The pitch of the sides of a wooden washing tray can be obtained as in Fig. 1, a centre line being squared across the sides and ends, and half the required length or width set off from

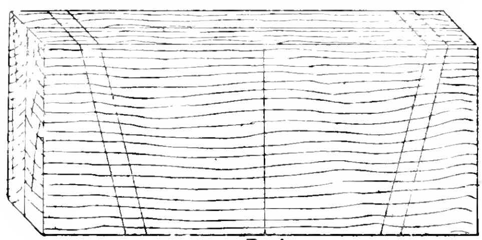


FIG. 1

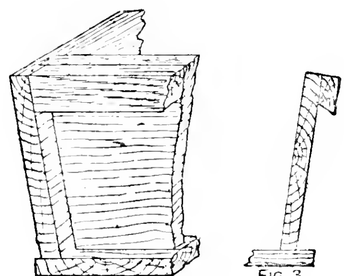


FIG. 2 FIG. 3

Making a Wooden Washing Tray.

it at both top and bottom. Then connect these marks as shown. The ends should be trenched into the sides for the full thickness, as shown in Figs. 2 and 3. The grip should be at the extreme top of the ends and should run quite across, so that two hands can take hold if necessary. Iron nails and screws may be used; the heads simply require a little putty over them. Fit the joints, make them tight, nail well, plane off the edges all round so that the bottom fits well, and put them all together without paper, paint, or white lead.

Converting Dry Plate Negative into Positive.—A negative may be converted into a positive by bleaching in the ordinary mercuric chloride intensifying solution, consisting of bichloride of mercury (or corrosive sublimate, a dangerous poison) 100 gr., chloride of ammonium 20 gr., water 2 oz., but the results are not satisfactory. An old process, known as the ababastrine process, has also been used, but as it depends on the action of chloride of mercury it cannot be considered successful. The formula, however, is as follows. Dissolve 40 gr. bichloride of mercury in 2 oz. water, and add 20 gr. sodium chloride (common salt) and 1 dr. hydrochloric acid. Either of the above formulæ may be used, the negative being soaked until thoroughly bleached, then well washed and, when dry, coated with any opaque black varnish. Unless the film is thoroughly freed from hypo before bleaching, the negative will be stained, or it may not bleach at all, remaining a dirty brown colour. The staining or the refusal to bleach occurs because the chloride of silver that is formed in the film is immediately attacked by the unremoved hypo, which is very weak.

Making and Bending Flash Glass.—Sheet glass up to the thickness of window glass is made by blowing a mass of pasty glass into a large hollow cylinder; the ends of the cylinder are then cut off, a dividing line is marked across its surface, and the cylinder is placed in a reheating furnace, where it opens and falls into a flat sheet. The bending of a sheet of flat glass involves a partial reversal of the above process. A muffle furnace must be provided, and a sufficient number of smooth blocks of iron, one surface being flat and the other surface curved to the required shape of the glass. The glass that is to be bent must be placed on the rounded surfaces of the iron blocks whilst the furnace is cold. The fire is then lighted, and the temperature gradually raised. When the muffle is at a red heat the glass will bend and assume the shape of the block on which it rests; the fire must then be allowed to die down, the muffle being kept closed, so that the glass may be properly annealed by slow cooling. This is an expensive method, but no other form of heating appliance would answer so well for small sheets as a muffle furnace. The glass must not be engraved before bending, otherwise there will be distortion, especially near the central line.

Blind-stitching Hair Mattress.—In blind-stitching Fig. 1 shows the first operation of putting in the needle, which must not be drawn out on the top, but backed out about 3 in. farther on the front; note that the needle is double-pointed for this purpose (see Fig. 2). This will leave inside the mattress a loop of twine (see Fig. 3), which, when drawn tight, will secure all the hair

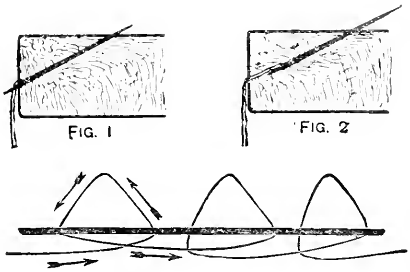


FIG. 1 FIG. 2

FIG. 3

Making Hair Mattress.

contained in the loop or stitch up to the edge of the mattress, thus forming the hard, square edge seen in this class of work.

Recipes for Furniture Polish Revivers.—Below are given twelve recipes for furniture polish revivers. (1) Besides thoroughly cleansing the furniture this reviver leaves a good polish, which is not easily soiled by finger-marks. Mix together spirit of wine 1 pt., vinegar ½ pt., boiled linseed oil ¼ pt., turps ¼ pt. Mix the spirit and vinegar first, shaking well till of a creamy colour; then add the other ingredients, and mix all well together, keeping it tightly corked. Apply with a clean cloth which must be dry, rubbing well in, and polish off with a dry flannel. (2) Thoroughly mix ¼ pt. lime water, ¼ pt. linseed oil, and then add ½ pt. sweet oil, well mixed, afterwards thinning with nearly ¼ pt. of turpentine. Apply with wadding or soft rag, wipe off, and finish with soft clean rag moistened (but not wet) with methylated spirit. If the work is very dirty or sticky with wax, it should first be well washed with weak soda and water. (3) To ½ pt. cold-drawn linseed oil add ½ pt. spirit of wine (meth.), ¼ pt. good vinegar, and two pennyworth of butter of antimony. Well shake this, and well rub in a little with a soft cloth, repeating the rubbing at intervals for one or two days, when a good polish will be obtained. (4) Warm 3 pt. of turpentine, 12 oz. of Castile soap, 12 oz. of white wax, 4 oz. of butter of antimony, and 1 gill of vinegar over a slow fire. (5) Mix together ½ pt. of vinegar, 1 noggin of methylated spirit, and a tablespoonful of raw linseed oil. Use on a piece of soft rag. (6) Before using this, wash the furniture with a solution of about two tablespoonfuls of extract of soap in a pail of warm water. To polish, apply the following mixture with a soft pad. Take ½ pt. each of linseed oil and vinegar, boil them together, and, when cool, add ½ pt. of methylated spirit. This method may be applied to polished or painted furniture. (7) A varnished or French-polished surface may be cleaned with soap and a moist flannel, a moist flannel alone, or a rag wrung almost dry after dipping in paraffin oil. The polish may be revived by rubbing with the following polish. A piece of gum sandarach as big as a walnut is simmered with ¼ pt. boiled oil till dissolved, and, when this is nearly cold, ¼ dr. Venice turpentine is added. Thin this, if necessary, with oil of turpentine. (8) A good renovating medium is camphorated oil, rubbed on very lightly and quickly with a soft flannel rubber. (9) Mix together equal parts of vinegar, sweet oil, and spirit of turpentine. Apply this with a piece of soft flannel, and rub down with a soft silk handkerchief. (10) Wash well with soap, soda, and water; dry well, then revive with raw linseed oil, vinegar, and paraffin oil in equal parts. (11) Mix together cold ½ pt. of linseed oil, 2 oz. of distilled vinegar, ½ oz. of muriatic acid, 1 oz. of spirit of wine, 1½ oz. of oil of almonds, ½ oz. of muriate of antimony, and ½ oz. of spirit of hartshorn. Shake the mixture and pour a little upon a clean rag, rub the furniture well, and finish off with a piece of clean, soft rag. The mixture must be shaken each time the rag is replenished. (12) Thoroughly mix together 1 pt. linseed oil, ½ pt. methylated spirit, ½ pt. white wine vinegar, and 2 oz. butter of antimony. Mix well together, shake each time used, put a little on wadding or flannel, and rub briskly. Wipe off with clean, soft rag.

Choosing and Fixing Spirit-level Tubes.—Spirit-level tubes are drawn out in a blowpipe flame; the tube, with care, does not cease to be a tube, though, when twisted hot, or broken cold and placed for a moment in the flame, it is quickly sealed up. These tubes are not quite straight, but the error is not great. A tube like Fig. 1 would be quite useless, as the bubble would divide into two portions, as shown, and no indication would be possible; but if the tube is turned over as

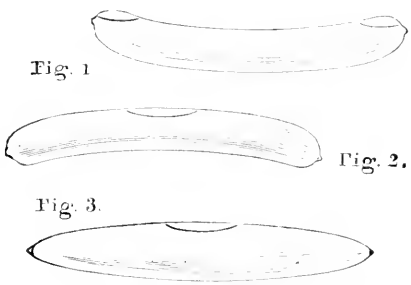


Fig. 1

Fig. 2.

Fig. 3.

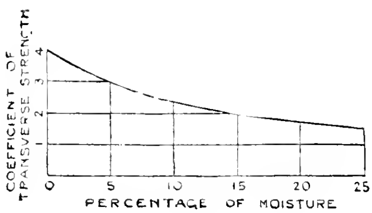
Choosing and Fixing Spirit-level Tubes.

in Fig. 2, the bubble promptly comes to the centre. The illustrations are purposely exaggerated. A tube that is quite straight for a portion of its length, and curves off towards one end, is very unsatisfactory; if the tubes could be uniformly larger towards the centre, as in Fig. 3, no care would be necessary in mounting. It is desirable that a tube, when set in place, should give similar indications when reversed, as in Fig. 3, although the surface is not level; this cannot happen unless the curvature of the tube is uniform, and the tube is uniformly set in its socket. Levels, as usually sold, are set on a tinfoil film, which makes the bubble more easily seen; in home-made levels a substitute may be employed. Mix dry plaster-of-Paris with a little powdered blue, or mix the plaster with water and blue ink; quickly set the convex side upwards, so that the bubble reverses equally at a slight inclination. An adjustable inclination is easily obtained by resting the tube on two screws inserted in the bench for a portion of their length. By this means, on reversing, the bubble ought to occupy similar positions as regards distance from the centre; then, after adjusting the screws until the bubble rests in the same place when reversed, the centre can be marked. Of course, long before this has been accomplished the plaster will have set; but this does not matter, as the under side can be adjusted by shaving with a sharp trying plane; treated thus, the level is more correct than if the tube were adjusted by the fingers. If the tube has been deeply embedded, the block containing it can be made parallel after the under surface has been adjusted.

Renovating Upholstered Furniture.—The following are instructions on renovating leather-covered furniture. Cut the strings that hold the buttons from underneath the seats; these strings can be drawn out on the top. The stuffing will now be loose and the bulged edges knocked up square. Get the seat surface as even as possible; then re-button with covered buttons, commencing near the edges. Tie these up as tightly as possible, so as to make deep tufts. Now dissolve 1 oz. of bleached shellac in ½ pt. of spirit and give the leather two thin, even coats, applied with a piece of sponge.

Steam Heating Laundry Drying Room.—Below are brief particulars of the method of heating a laundry drying room 20 ft. by 16 ft. by exhaust steam. A room 20 ft. by 16 ft. should have at least two 2½-in. pipes all round, and three pipes would be desirable. A better arrangement is to put two-thirds of this quantity of pipe in rows across the room so as to get a well-distributed heat. A drying room, to be effective, must have very free ventilation. Heated air absorbs only a certain amount of moisture. A constant change of air is, therefore, absolutely necessary. A 2½-in. exhaust service will be suitable, and, after passing through the drying room, it should still be capable of heating water in a tank. It will be desirable to fit a "separator" as near the engine as convenient to remove the grease vapour from the steam, otherwise it will in time collect in the heating pipes. To run this exhaust service, take it to its highest point immediately it leaves the engine—that is, high enough to allow of a fall of 1 in. in 10 ft. all the way to its final outlet. This is to prevent the collection of condensed water at any point. The heating pipes in the drying room can be close down on the floor.

Ascertaining Strength of Timber.—The machines used for testing the tensional, compressional, and other strengths of timber and other materials are very elaborate and very expensive, as the experiments must be efficiently carried out. In testing for tensile strength, the piece of timber may be from ½ in. to 3 in. square, held between toothed jaws, or shouldered and held between clips, but it is essential that the stress should be direct, that is, in the true axial line of the piece. The same sizes may be used for testing compressive strength, the ends being made perfectly true and square, and not shouldered. Timber



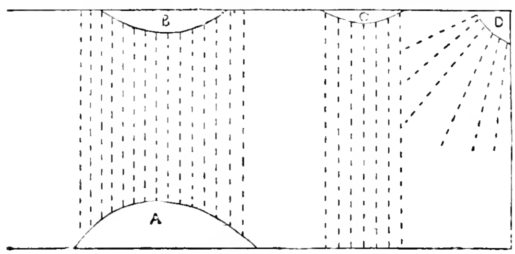
Ascertaining Strength of Timber.

is, however, more often tested for transverse strength, and home experiments may be made which will give a rough approximation. What is wanted is to find a value for c in the formula $W = \frac{c\,b\,d^2}{L}$, where W is the breaking load, c a co-efficient varying with the material and the mode of loading and supporting, b the breadth in inches, d^2 the depth in inches squared, and L the clear span in feet. If the piece be simply supported at both ends and loaded in the centre, c will be about 3½ cwt. or 400 lb. for fir or deal. Say a piece of straight yellow deal, ¾ in. square and 3 ft. long, carefully prepared, and laid across two supports fixed level at a distance of 24 in. from each other, and an empty galvanised iron bucket hung on the centre of the beam. Then the bucket can be gently filled with dry sand until the small timber beam cracks and breaks. It can be arranged that the bucket does not fall far, and then the bucket and sand can be carefully weighed. Suppose it to be 80 lb., then the calculation will be $80 = c \times \frac{\cdot75 \times \cdot75^2}{2}$; $80 = c \times \cdot2109$; $\therefore c = \frac{80}{\cdot2109}$ = say 380 lb. or $\frac{380}{112}$ = say 3·4 cwt. If the timber contains moisture from want of seasoning or otherwise, the fibres will tend to slide on one another and yield with a smaller load. The effect of this moisture may be shown by plotting the results to a curve, as in the illustration herewith, which is hypothetical only.

Underground Rain-water Tank.—Rain-water tanks should be designed to suit their positions, and only a general description of their positions and construction can be given. The tank should be only a short distance from a house or building, so as to shorten the lengths of the drains leading to it, and should also be near the place where the pump necessary for raising the water can be fixed. The selected site should not be near any soil or sewage drains or any other place where there would be risk of the water becoming contaminated. After the excavation has been made to the desired size and depth, the bottom should be covered with Portland cement concrete from 9 in. to 18 in. in depth, according to the size of the tank and the nature of the soil in which it is being built. The walls should be from 12 in. to 18 in. thick, and made of concrete, or built with bricks in cement, and rendered inside to make it watertight. Some engineers puddle the outside with clay. The tank can be arched over or covered with rolled-iron joists about 18 in. to 24 in. apart, and filled in between with Portland cement concrete. An access manhole should be made in a suitable position, and have a raised curb round it and a flat stone or hinged oak cover. The overflow should be made of ordinary drain pipes, and be arranged to discharge into the open air in a field or other suitable place, but not into any soil or sewage drain. A trap is not required, but in some cases an iron grating on the outlet end is necessary for keeping out rats or other vermin.

Lacquering Brass.—Heat the article to be lacquered on a hot plate or in an oven; when it is hot enough, which must be found by trial, apply the lacquer with a camel-hair brush. If the right temperature has been attained, there should be a slight hissing when the lacquer is applied. Reheat the lacquered article and then allow to cool; the lacquered surface must not, while it is hot, be touched with the fingers.

Levelling Thin Metal Plates.—A good method of levelling thin metal plates, such as No. 20 wire gauge, is the following. In the illustration the plate to be set is "loose" at A B C D; to make it flat, the parts of the sheet opposite the buckled edge must be stretched with a setting hammer, used upon a large circular iron slab, known as a setter. The dotted lines upon the diagram indicate the places at which the blows are to be delivered, and a few additional blows along the centre after the



Levelling Thin Metal Plates.

buckles are drawn out will stiffen the sheet. Buckling in sheets of metal is due to impurities in the metal, to a defect in the rollers, or to unequal annealing.

Estimating the Value of Standing Timber.—In some localities the value of standing timber is made out by a surveyor who has specialised in this class of work. His calculations are based on the apparent cubical contents of the trees growing over a given area; and their exactness will necessarily depend on the experience he has previously gained. But sight measurement can seldom be relied upon. The only satisfactory method of estimating, and the one most often followed, is to measure the timber height and girth of each tree on the plot separately. In such cases the trees are numbered, and the survey is conducted as here indicated:—

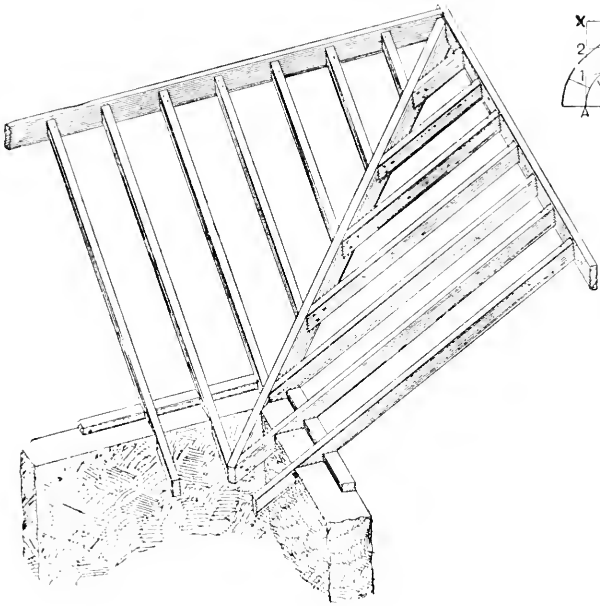
1898 Cutting. *Treffgarne Hall Woods.* *Woodmoor Section.*

No. of Tree.	*Kind of Tree.*	*Cubic Ft. contained.*	*Price per Ft.*	*Value.*
			s. d.	*£ s. d.*
30	Ash	40	2 6	5 0 0
31	Larch	28	2 0	2 16 0
32	Elm	80	2 0	8 0 0
33	Oak	64	3 0	9 12 0
etc.				

The first thing to ascertain is the price per foot each kind will realise when delivered at the place of sale. The price to be paid for the standing timber will then be found after the following items have been deducted—1, cost of survey; 2, cost of felling; 3, cost of cartage, or rail, to market; 4, construction of temporary roads, or gaps through fences, and making same good; 5, extras to additional labour, etc., on account of difficult nature of ground; 6, profit. Firewood, if included, is to some extent a recoup on the above, but it is usually sold under separate agreement.

Gilding Liquid for Dipping Metals.—For a liquid solution for gilding brass and bronze, dissolve ¼ oz. of gold chloride in 5 qt. of distilled water; then add 2½ lb. of caustic potash, 5 oz. of pearlash, and 2 oz. of cyanide of potassium, and stir until all is dissolved. Dip the articles in this solution whilst at a nearly boiling temperature. The colour of the gilding will be affected by the temperature of the solution, and it may be necessary afterwards to work up the surface with a brush. A solution for gilding silver and German silver may be made by dissolving 20 grains of gold chloride in 1 pt. of distilled water, then adding gradually 1½ oz. of acid carbonate of potassium. Mix this with another solution containing 1½ oz. of acid carbonate of potassium in 1 qt. of water, and boil the mixture until it turns green, when it is ready for use. Silver articles to be gilded in this solution must be attached to thin strips of zinc. Gilding by this process may be made more permanent by first thinly coating the articles with mercury in a solution of nitrate of mercury.

Fixing Valley and Jack Rafters.—The accompanying conventional sketch shows the best method of fixing valley rafters and jack rafters on a roof. The valley rafters are notched over the wall-plate, and cut between the ridges. The jack rafters are fixed to the valley rafter and ridges.

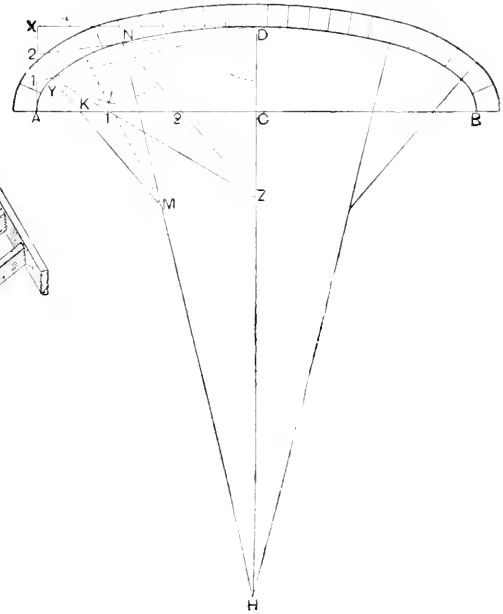


Fixing Valley and Jack Rafters.

How to Make an Effervescing Saline.—The simplest kind of saline is made by mixing together 1 oz. of tartaric acid and 1 oz. of bicarbonate of soda. If required sweetened, mix with 2 oz. of finely powdered sugar. All the powders should be thoroughly dried before mixing. Seidlitz powders are very useful salines. The powder in the blue paper contains 2 drachms of Rochelle salt and 2 scruples of bicarbonate of soda. The powder in the white paper contains ½ drachm of tartaric acid.

Repairing Worn Stone Steps.—In many instances the worn parts of stone steps can be made good with silicon treads. In executing such a job, the first thing is to centre the step; if economy has to be practised, make the centre where the stone is worn deepest, which will be near the side on which the handrail, if there is one, is fastened. If the cost is immaterial and a well-finished appearance is required, centre the step so that there is the same width of margin on each side. The middle point can be made the centre of a tread (the treads are 6 in. square) or it may be at a joint, according to the number of treads. Six or seven treads are generally sufficient to replace the worn part of one step. Cut out sufficient to take an exact number of whole treads, and do not allow for a bed deeper than ¼ in. The treads should be tried in position in order that no cutting may have to be done after the bed is spread. Wash the sand through a fine sieve, and gauge 2 parts of it to 1 part of Portland cement. Wet the steps if they are too dry, but do not wet the treads, as they are almost impervious to moisture, and the addition of water makes them too slippery. Having spread the bed, hold a straightedge on the face of the riser to keep the treads from slipping forward, and with another straightedge tap the treads to their proper level. This tapping will cause the cement to come up between the heads and thus form a solid cross-joint, which should not be more than ⅛ in. wide. Cover with boards, which must be kept clear of the treads, and in twelve hours' time wet the steps, and keep them under water for four days. After this they will not require further protection.

Setting Out Semi-elliptic Arch.—The semi-elliptic arch, suitable for masonry construction, shown in the accompanying illustration is set out in the following manner. First draw the span A B and the rise C D, and draw A X and D X parallel to C D and C A respectively. Divide A X and A C each into three equal parts, make C Z equal C D, and draw lines through the points, as shown, intersecting each other at Y and N. Make the angle D N H equal to the angle N D C, and produce D C to meet N H in H; then H will be the first centre. Join Y N and bisect it, cutting N H in M, which will be the second centre from which the curve Y N is struck. The curve A Y is obtained in a similar manner, and the other side of the arch, being symmetrical, is easily found.



Setting Out Semi-elliptic Arch.

Measuring Buildings.—In measuring up a newly built house so as to enable complete drawings to be made, commence with the ground plan and measure carefully, as everything else must fit this plan. Take the outside dimensions first, then the inside. Then measure first floor, second floor, attics, and cellars. Next take the height from floor to floor at the staircase for the sections. For the elevations make sketches and count the courses of brickwork for height, and the number of bricks in length for intermediate points of width. Details of windows, if mullioned, etc. may be measured by opening the window and reaching out. The pitch of roof must be obtained or assumed, and the roof plan may generally be drawn by repeating the plan of the lower floor and noting where the ridges come. All measurements should be marked on the sketches. Draw out the ground plan first, and test everything else by it. Any roof spaces, etc., not accessible may be left blank or details assumed; the whole thing may be done without a ladder with sufficient accuracy for the purpose. Details of floors, stairs, cornices, etc., seen in the sections may be left until the last.

Hand Shears for Cutting Sheet-iron.—Fig. 1 is an elevation of a pair of shears suitable for cutting stout sheet metal. The top bar is of iron 3 in. by 1 in. thick, on which the top knife, of best cast steel 2 in. wide by ½ in. thick, is fixed, and hung at the end of the supporting bracket by bolt and nut. The supporting bracket is of wrought flat iron, 3 in. wide by 1¼ in. thick. In the top of this bracket is fixed the bottom knife of best cast steel, 2 in. wide by 1 in. thick. The upper bar in which the upper knife is fixed is moved by a long handle working from an outstanding portion of the supporting bracket at A, connected to the upper bar and knife with square connection, pinned to both rail and handle. The ironwork is bolted to a wood block, dovetailed into a 3-in. plank 11 in. wide. The whole arrangement should be slightly on the slope. This is done by setting the shears end of the machine on a block of wood 3 in. thick. Fig. 2 is a plan of the ironwork in position, with the knives as they meet each other. The wrought-iron supporting bracket is affixed to the wood block by square-head bolts.

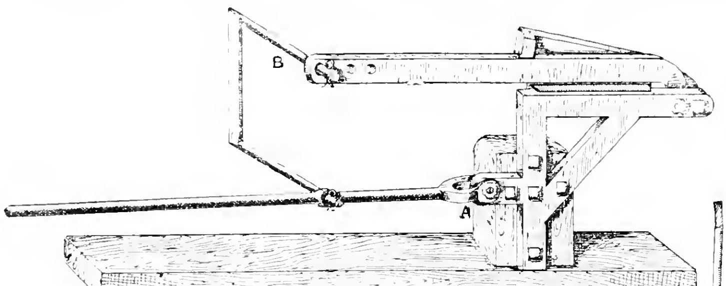


Fig. 1

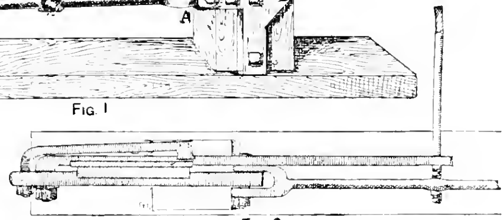
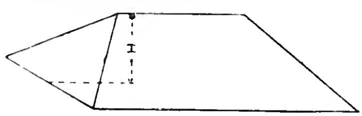


Fig. 2

Hand Shears for Cutting Sheet-iron.

Determining Contents of Heaped Material.—The contents of a heap of material, shaped as illustrated, can be found approximately by multiplying the length of the base by the width and by the perpendicular height H of the mass, and then dividing the final product by 2. If all of these measurements are in feet, the result will be in cubic feet. To determine the height in feet, when the length of the sloping side is given, square this length in feet and subtract the square of half the width, also in feet.



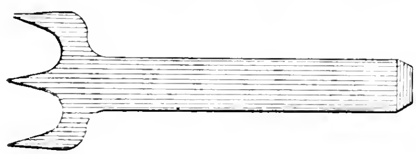
Determining Contents of Heaped Material.

Then extract the square root of the remainder. Applying this to a heap 23 ft. long by 12 ft. wide with a sloping side of 9 ft., the perpendicular height will be $\sqrt{81-36} = \sqrt{45} = 6{\cdot}7$ ft., since the square of 9 is 81 and of $\frac{12}{2} = 36$. The contents will therefore equal $23 \times 12 \times 6{\cdot}7 \div 2 = 925$ cub. ft. (say).

Cause of Blue Colour in Nickel.—When a thin coat of nickel is deposited on iron and steel, the underlying metal gives its tint to the deposited nickel when polished. A similar bluish tint is observable in nickel deposited from an old solution contaminated with base metals. In such cases the colour of the deposit may be improved by adding to the solution common salt (sodium chloride) at the rate of 1 oz. of salt to each 6 gal. of solution at first; then note the results. If an improvement is observable, add more salt; but it is not advisable in any case to add more than 8 oz. per 6 gal. If the deposit is still bad, the solution is unfit for use.

Producing Skeletons of Animals.—For such animals as horses and dogs, first take away the skin and the internal organs, and then with the knife remove the greater part of the flesh. Next place the bones in frequently changed water until the flesh has putrefied, and then either pick or wash it off. This, though very disgusting, is the method usually adopted. Much work may be avoided by gently boiling some of the bones in several changes of water until the flesh can be removed whilst hot with blunt pieces of wood. If the bones are boiled, allowed to soak in cold water for some days, and then exposed to sun and air, most of the grease will have disappeared and the bones will have become bleached. Dry soap, washing powders, or soda will greatly assist. Chloride of lime made into a weak solution with water is commonly used for bleaching bones. Do not exceed 1 oz. of chloride to 1 pt. of water, as if too strong the solution spoils the bones. Or cover the bones with equal quantities of peroxide of hydrogen and dilute ammonia in an earthenware vessel. Finally wash in clean water. Expose to sun and air to dry. To bleach naturally, wet the bones and expose to sun and air, repeating as often as necessary. During both the maceration and the boiling the connections or ligaments will give way, so that it may be advisable to tie or bind the bones with wires (copper preferred) before beginning the work. After the bones are cleaned they must be permanently joined by brass or copper wires of sizes to suit the bones, holes being drilled for the purpose.

Close-studding the Edges of Upholstered Chairs.—For close-studding the edges of upholstered chairs, procure a gauge to the shape of the accompanying sketch. For ordinary ⅜-in. brass studs the points of the gauge should be ½ in. apart. In marking for studs, put the last point of the gauge in the last hole made before striking again, to ensure that the holes shall be at equal distances apart. To save burring the stud heads, drive in with a raw hide mallet.



Gauge for Marking Positions of Studs in Upholstery.

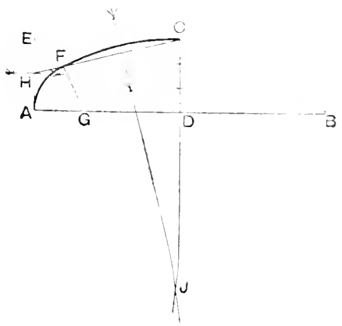
Mahogany Stain.—Dragon's blood, used in making mahogany stain, is generally sold as a red powder; it readily dissolves in methylated spirit, yielding a bright red stain generally considered, if used alone, too fiery for a good imitation mahogany. In conjunction with other stains or mordants, as nitric acid and carbonate of soda, it gives better results. A cheap mahogany stain can be made by mixing burnt sienna (ground in water) in stale beer or vinegar. Colour, such as dragon's blood or Bismarck brown, in the polish or varnish used afterwards will give to this stain a richness of tone far superior to that obtainable by dragon's blood alone.

Pneumatic Pedals for Piano.—In applying pneumatic action to the pedals of a piano, a bellows about 1 in. long by 1½ in. wide, and opening about 1 in., will be needed for each pedal. The bellows is closed by a spring underneath and opened by the downward pressure of the pedal. It is connected with a distended bellows of about the same size under the key; this bellows, being emptied by the action of the pedal, acts on the key by a tracker. The bellows are connected by a compo tube, and the key bellows are in two rows.

Hints on Photographic Backgrounds.—Generally a medium tone background is best for light dresses. If it is too dark, the tones in the dress will probably be lost; if too light, the figure may be lost in the background, but better gradation may result. Of course, much depends on the lighting: with a flat front light suitable for hard, thin faces with a bad outline, the background will appear lighter, and with the light behind the figure it will be darker. Photographers usually have at least two graduated backgrounds, the middle tint of one being equal to the lightest tint of the other. The backgrounds should be in a neutral tint, otherwise it is difficult to gauge their effect. A good plan is to get a dull plaster cast and photograph against sheets of paper of various tones.

How Vaseline is Made.—Vaseline cannot be made on a small scale; it is one of the products of the distillation of natural American petroleum, and is a perfectly homogeneous body, remaining as a jelly for an unlimited period. An imitation of vaseline may be made by dissolving 1 part of paraffin wax in 4 or 5 parts of pure heavy mineral lubricating oil.

Striking out an Elliptic Arch.—The accompanying diagram represents an easy way of striking out an elliptic arch. First draw the span A B and the rise C D, then the parallel line A E the same length as the rise. Divide the rise C D into three equal parts, of which two-thirds is the radius at A F G to strike the shoulder of the arch. Then bisect E A, and from the point H obtained



Striking Out an Elliptic Arch.

draw line to C; then square off centre of F C to intersect at J; then with J as centre and J F as radius describe the crown of arch from F to C.

Preventing Moths Attacking Clothes.—Try one of the following remedies for preventing moths attacking clothes. (*a*) Keep the clothes in a trunk made of cedar wood. (*b*) Sprinkle some oil of birch on a piece of cloth or flannel and place it in the box with the clothes. (*c*) Sprinkle some Keating's insect powder on the clothes before folding them up. (*d*) Place some albo-carbon (obtainable from the ironmonger) in the clothes box. To remove moths from clothing, it should be stoved; or the clothes may be taken out of doors and well shaken, then well brushed and carefully examined inside and out.

Making Blue-black Writing Inks.—One method of making blue-black ink is to digest together 7 oz. of bruised galls and ½ oz. of bruised cloves for about a fortnight in 5 pt. of water. Filter and add 3 oz. of sulphate of iron and 1 fluid dr. of sulphuric acid. Well shake until the ingredients dissolve properly, and add 1 oz. of indigo paste, and again filter if desirable. Galls for ink-making should always be bought whole, as, if already bruised, it is impossible to estimate their value. The best galls are known as Aleppo; they have a warty surface, are blue or green, and should be heavy and free from holes (showing that they have been collected before the insect has escaped). English galls are of no value. For use, the galls are broken up into a coarse powder in an iron or bell-metal mortar. (2) Dissolve in 12 oz. of water 7 oz. of sulphate of iron and 20 drops of sulphuric acid; in a similar bulk of water dissolve about 1 oz. of tannin. Dissolve in 1 oz. of alcohol—spirit of wine—24 gr. of methyl blue. Add to the first solution the methyl and alcohol, then add the tannin water, and shake. This does not need to be kept to mature, as do the indigo inks. (3) Rub 6 parts of Prussian blue with 1 part of oxalic acid and a little water to a smooth paste and dilute with water. (4) Work together 15 parts of bruised galls, 5 parts of ferrous sulphate, 4 parts of iron filings, 200 parts of water, ½ part of indigo, and 3 parts of sulphuric acid. (5) A blue-black ink, but one which appears violet at the time of writing, is made by bruising elderberries, and setting them in a warm place for three days to ferment; strain, and add to each 6 pt. of juice ½ oz. of sulphate of iron and ½ oz. of acetic acid.

Pinhole Photography.—The principles of pinhole photography—or photographing without lenses—are extremely simple. The discs of light thrown on the ground when the sun's rays filter through intervening foliage are natural examples of pinhole photography, each of these discs being an image of the sun. If a small hole is made in a card and held in front of a lamp, an inverted image of the lamp will be thrown on any white surface facing the hole. The clearness of this image increases as the size of the hole is diminished and as the receiving surface is shielded from extraneous light. The brilliancy of the image increases with the enlargement of the hole and with its nearness to the receiving surface. But the definition remains the same. There being no focus, the pinhole camera gives the maximum depth of focus. If two holes are made close together, two overlapping images result; and if a third hole is placed between the other two, the third image may blur the other two beyond recognition. Pinhole photography, therefore, is only possible with a small hole, and is applicable only to brightly illuminated inanimate objects. Captain Abney's rule for determining the best diameter of the pinhole is to multiply the square root of the distance between plate and

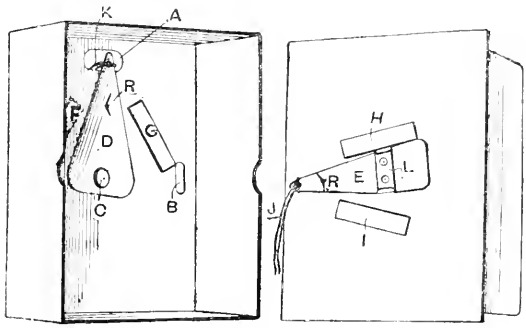


FIG. 1 FIG 2

Pinhole Camera.

pinhole by ·008. An ordinary camera may be used as a pinhole camera by constructing a close-fitting front with a sliding metal plate containing holes of different diameters. Chapman Jones recommends the following table, which is worked out according to Captain Abney's rule,

Pinhole diameters in inches	$\frac{1}{16}$	$\frac{1}{22}$	$\frac{1}{32}$	$\frac{1}{45}$	$\frac{1}{64}$
Distance between plate and hole for sharpest image in inches ...	64	32	16	8	4

The fractions may then take the place of the *f* ratio in estimating exposure; which, with a subject that would require one second at *f* 16, will be just as many minutes as the plate is inches from the hole. Or estimate the exposure for the *f* number and multiply by the square of the distance. Thus, supposing the hole $\frac{1}{64}$ in. at 4 in. is used and for the subject in hand the exposure for the same plate under the same conditions at *f* 64 would be ten seconds, then in this case the exposure will be 10×4^2 or 160 seconds. To make a pinhole camera, procure a cardboard box, whose lid and the box itself should each be 4 in. deep; cover the outer sides of the bottom of the box with thin velvet so that the box will be completely enveloped and will be light-tight when the lid is on. Cut in the front of the box three openings A, B, C (Fig. 1) of the size and shape shown. Now make another box with projecting sides (Fig. 2) to fit inside the first. Cut two pieces of metal as D and E, and rivet to the two boxes as shown at R so that they move freely and independently. Glue on strips of card F, G, H, and I to form stops, and attach the cords J and K. The piece E has a second piece bent over it, and between these is fixed a piece of tinfoil or extremely thin copper L containing two holes $\frac{1}{64}$ in. and [illegible] in. diameter, either of which may be pulled into position when required. The plate is laid face up in the back of the outer box and is held upright by the inner box when the latter is pushed in. Pull the cord so that the proper hole comes into position in the centre, and close the shutter with the other cord. Stand up facing the view and open the shutter for the required exposure.

How to Make a Shutter for Taking Photographic Doubles. The accompanying sketch shows an arrangement for doubling the same figure on one quarterplate. Construct a framework A in $\frac{3}{4}$-in. wood, having holes B^1, B^2, B^3, B^4. Into these fit the rods C, C. The holes should be slightly smaller than the rods, and the latter should be cut down to form a shoulder, thus keeping them in position. Cut two pieces of wire, each equal in length to two sides of the frame, and sharpen the ends. Bend these to the shape shown (D and D^1) and fix into the two rods so that the two centres almost touch, thus forming the framework of two doors, made light-tight by covering with thin velvet. These doors should fit exactly, and are, of course, turned by the rods C, C, which project about $\frac{3}{8}$ in. beyond the frame. Fit into the inner side of the framework a second frame about $\frac{1}{2}$ in. by $\frac{1}{2}$ in., against which the doors shut, making a light-tight join. To the projections just mentioned are fastened cog-wheels E and E^1. Now take a stout knitting needle, and wind around it some brown paper, sticking it down with paste to form a paper tube. Measure half the circumference of the cog-wheel, and cut the needle down flat for this distance, leaving about an inch or so to fit the tube (both may be made from one needle). Notch the flattened part to fit the cog-wheel. The tubes are next fixed through the camera front as shown in section in Fig. 2, and the racks inserted. It will be seen that, if air is forced through the tube, the rack is blown out, carrying the wheel round with it. An extremely thin rubber band F fastened from the inner side of the door to the frame suffices to pull it back. To each of the tubes projecting outside the camera it will be necessary to fit 6 ft. of small tubing, connecting them at the end with a Y-shaped double tap like Fig. 3. By opening one door and keeping the other closed, one-half of the plate may be exposed, the process being repeated for the other half. The two images overlap or vignette into each other, so that no join is shown, provided the doors are not too far from the lens. The doors should be at a distance from the lens of about half its focus. If too near, too much of the plate will be exposed. For this reason the exact dimensions cannot be given. The position to be occupied is focussed with one door open and one shut, alternately, the alternate door being closed by turning the tap. The ball for operating the shutter is placed on the floor, to be worked by the foot.

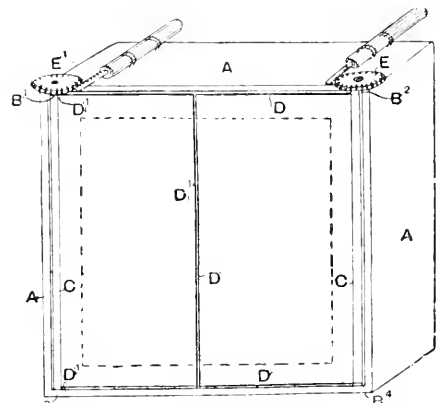


FIG. 1

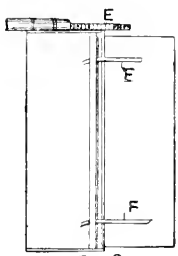


FIG. 2

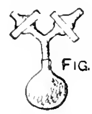


FIG. 3

A Shutter for Taking Photographic Doubles.

Recipes for Black Inks.—The following recipes are for black writing inks. (1) The common ink sold at oil shops at 1d. per gill can be made very cheaply. Boil in a copper 8 gal. of soft water, throw in 7 oz. of logwood extract, and put out the fire to stop the boiling. Add 1 oz. of bichromate of potash and 80 grains of prussiate of potash, and after straining, bottle it. (2) Bruise 6 oz. of best Aleppo galls, and boil in 6 pt. of water for several hours, adding more water to supply the loss by evaporation. Strain whilst hot through calico into a clean vessel. Add 4 oz. of gum arabic, and boil till dissolved. Strain again whilst hot into a stone bottle, and add 4 oz. of sulphate of iron, previously dissolved in water. To preserve from going mouldy, add 3 drops of creosote for each pint of ink. The ink, to appear thoroughly black, must be kept for some time before using. (3) A black aniline ink is prepared by rubbing 60 gr. of aniline black with 60 drops of hydrochloric acid and $1\frac{1}{2}$ oz. of alcohol. Dilute with 3 oz. of distilled water in which $\frac{1}{2}$ oz. of gum has been dissolved. (4) Digest $\frac{1}{4}$ lb. of logwood chips for about twelve hours in 3 pt. of water and simmer gently till 1 qt. is left. When cold, decant and dissolve about 20 gr. of yellow chromate of potash in the solution, which must be well stirred the while. (5) For a cheap ink dissolve a threepenny packet of Judson's dye in a small bottle with a little hot water, and add cold water according to the strength of colour desired. When required for use, pour a little into the inkpot, and dilute with water as required. (6) To make black writing ink that will not be affected by water after writing, boil $\frac{1}{2}$ oz. of lump borax with $\frac{1}{2}$ pt. of clean water in a clean covered pot. When the borax has dissolved, add 1 oz. of bleached shellac and stir till dissolved. Add sufficient vegetable black that has been thoroughly mixed with water on a palette with a palette knife till it is free from lumps and forms a thick paste. (7) Shellac dissolved in methylated spirit and covered with aniline dye makes a bright waterproof ink, but this is rather difficult to use, except in cold weather, as the spirit evaporates and leaves the ink on the pen too thick to flow. It works all right if rapidly brushed on.

How to Make a Sheet Brass Table Lamp.—Fig. 1 shows the table lamp complete. For it, cut two circles of sheet brass (No. 22 gauge), each $7\frac{1}{2}$ in. in diameter. Hollow both together on a block until quite smooth, so that each resembles a bowl. Turn up a small edge on each with a jenny or bottom stake, so that one will fit inside the other. Procure a No. 2 Hinks's Duplex burner, or, better still, a complete central draught burner. Measure the bed, and cut a hole $\frac{1}{4}$ in. less in diameter in the centre of the larger bowl; turn up the edges for $\frac{1}{8}$ in. so that the bed will fit tightly over, and solder this on from the inside. Then fix the hollows together, the edge of one inside the other, and solder well round. This constitutes the oil vessel. To make the stand, cut a circle of sheet brass 7 in. diameter and hollow it not quite so deeply as the other vessel. Swage it round, leaving it plain for $\frac{1}{2}$ in. from the edge to produce a mould-like appearance and to increase the strength. Cut another circle $4\frac{1}{4}$ in. diameter, hollow it deeply, and file it perfectly plane at the edges. Cut a hole $\frac{3}{8}$ in. less in diameter in the swaged circle, which, when edged $\frac{3}{16}$ in. all round, will allow the smaller circle to fit tightly over it. Solder this well from the inside. Now make a taper tube 4 in. long, $2\frac{1}{2}$ in. diameter at one end, and $1\frac{3}{4}$ in. diameter at the other. This must be cut according to the pattern, Fig. 2. Bend it round over a mandrel, and braze the joint with soft brass spelter, using borax as a flux. File the joint smooth, and raise three small rings with a hand swage, starting $\frac{1}{8}$ in. from the widest end; see A (Fig. 1). Cut a hole, in diameter equal to the tube at its larger end, out of the small hollow, which is now fixed to the swaged hollow. Drop the tube in, beat over the protruding $\frac{1}{4}$ in. to the inside of the small hollow, and solder round from the inside. Then make a brass socket B (Fig. 1) and solder it to the bottom of the oil vessel. Now fix the stand on a flat surface, drop the oil vessel over it so that its socket fits tightly over the tube of the stand, square it, and then solder them together. Turn the lamp upside down and solder a disc over the larger end of the taper tube. Fill the bottom with sand, and then solder a disc on to prevent it escaping. The lamp will then not readily be overturned. Remove solder from outside the joints with a smooth file, scrape with a steel scraper or sharp pocket-knife, and polish with emery and oil, finishing with bath brick and turps.

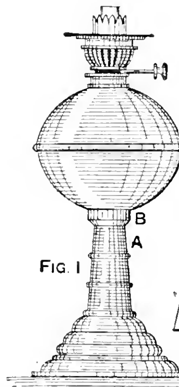


FIG. 1

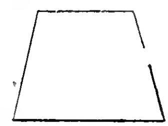
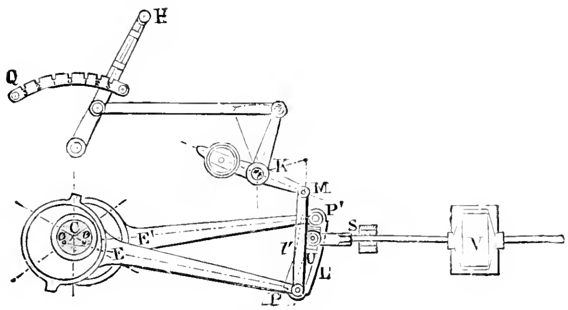


FIG. 2

How to Make a Sheet Brass Table Lamp.

Recipes for Blue Writing Inks.—These are recipes for blue inks. (1) Place in a tumbler a teaspoonful of soluble Prussian blue pigment, and add sufficient pure water to dissolve all the blue and make it of the proper consistency for use as ink. (2) Allow 1 oz. of powdered indigo to stand in 7 oz. of oil of vitriol for forty-eight hours. Stir occasionally, and then add 8 oz. of water, thus forming sulphate of indigo. A permanent blue ink is made by dissolving 3 oz. or 4 oz. of this sulphate in 1 gal. of water. (3) Dissolve 3 parts of Prussian blue and 1 part of oxalic acid in 30 parts of water, and add 1 part of gum arabic. (4) Dissolve soluble Paris blue (cornflower blue) in alcohol. (5) Dissolve 2 oz. of Chinese blue in 1 qt. of water and add 1 oz. of oxalic acid, when the ink is at once ready for use.

Stephenson's Reversing Gear for Locomotives.—The adjoining illustration shows the Stephenson reversing gear. V is the slide valve, and C the crank-shaft carrying two eccentrics E and E′, with centres as shown. A link L carries a die U connected to the valve rod, which works in a guide S. The hand lever H can be moved over the sector Q, and can be locked in any one of the notches shown. This lever, by means of a balancing system of links, etc., at K, M, r, etc., moves the curved link L. To this link at centres P and P′ are connected the eccentrics E and E′. By altering the position of the link either eccentric may be put in gear. For instance, as shown, the valve would receive motion from E′, but by moving the handle over to the other side of the sector Q the die block would be at the lower end of the link and E would be in gear. With the handle at the centre of the sector, the die would be at the centre of the link and the valve would receive no motion from the eccentrics, the forward movement of one being partly balanced by the backward movement of the other eccentric. As the eccentrics are not exactly opposite, the valve, in mid gear, opens to lead only. To reverse the end, it is only necessary to put in gear the eccentric that was previously not in gear.

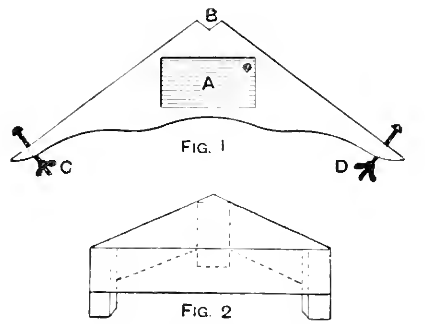


Stephenson's Reversing Gear for Locomotive.

Case-hardening Large Wrought-iron Work.—The ordinary methods of case-hardening are quite inadequate when large wrought-iron forgings of perhaps irregular shape require to be treated. These are box-hardened in the following manner. For the heaviest work, cast-iron boxes of circular form with cast-iron covers are used. They are of sizes suitable for the work in hand, ranging between 1 ft. and 2 ft. 6 in. in diameter. For small work, tubes of wrought iron or old pulley bosses are used. The bottom of the box is covered with a thick layer of the hardening material, which may consist of bone dust, leather clippings, or hoofs, mixed with salt or charcoal powder. Care must be taken to give the forgings good support among the material, so that they shall not become distorted by their own weight while at a red heat. When the box is filled with alternate layers of metal and of material, the cover is put on, and luted with fireclay to make it nearly air-tight. It is essential that air be excluded. Then it is placed in a fire or, preferably, in a reverberatory furnace, for from ten to thirty-six hours. The time during which the box is exposed to the heat of the furnace mainly regulates the depth to which the metal will be hardened. The chemical activity of the hardening agents, however, influences the result. The addition of powdered yellow prussiate of potash is often an improvement. The forgings are turned out into cold water, and are thus hardened to a depth which ranges from $\frac{1}{64}$ in. to nearly $\frac{1}{8}$ in. But in the same forgings the depth of the hardening will not be quite uniform. For light articles, of course, a mere film of surface hardening is enough; for heavy work the steely casing should penetrate to nearly $\frac{1}{8}$ in. Since hardening distorts the work, the minimum amount of penetration that is consistent with the purpose for which the forgings are required should be imparted to them—$\frac{1}{16}$ in., or a bare $\frac{1}{16}$ in., may be taken as a good average. The distorted outlines have to be corrected with an emery wheel or with emery paper.

Cause of Thin Photographic Negative.—Thinness or want of density in a negative may be accounted for in two ways—by weak development owing to insufficient proportion of the actual image maker, pyro and metol, and by too early removal from the bath. Thinness is also caused indirectly by over-exposure and by insufficient potassium bromide. With a pyro-metol developer, some time must elapse after the details appear in order to obtain density, even though the picture seems to be veiling over.

How to Make a Portable Photographic Dark Room.—Here are instructions on making a portable triangular dark room. Make three uprights 6 ft. long of $1\frac{1}{2}$-in. stuff, and six cross battens 3 ft. 2 in. long. The top of the dark room consists of a triangular piece of wood 3 ft. 6 in. by 3 ft. 6 in. by 3 ft. 6 in. Recesses are cut at the corners to receive the uprights, and the cross battens, which give stability, are fastened to the uprights on two sides at suitable places, and in the third side, which forms the door, one batten should be at the top and one at the bottom. The developing table is shown in Fig 1, A being the sink, which is a metal dish sunk in a recess; the dish is fitted with a pipe to carry off drippings to a bucket below. The table should be coated with paraffin wax. B shows a notch to take the upright, and C and D are wing screws that fasten the board to the other uprights. To facilitate packing into the smallest possible compass, wing screws can also be used for the battens. The room must be ventilated by cutting an opening in the top piece. The opening should be triangular, 1 ft. by 1 ft. by 1 ft., and it should have raised sides like a chimney, 6 in. high. Over this chimney is fitted a cap which is so made as to admit of the free passage of air while excluding light. The construction of the cap (Fig. 2) is sufficiently explained by the illustration. The frame may be covered with two thicknesses of glazed lining, and a piece of ruby fabric can be let in on one side to form a window. The covering over the door side—which should overlap the whole width to form a light trap—may be hung on rods or suspended from hooks.



Details of Portable Photographic Dark Room.

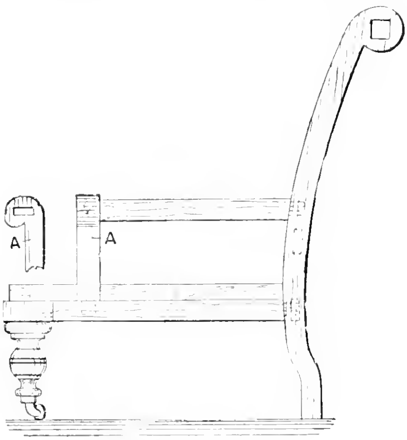
Blacking Letters on Headstones.—Black japan, which can be obtained from most oil and colour stores, will be found most suitable for lettering headstones. Use a small sable-hair brush for the purpose. Drop black, ground in turps and thinned with good carriage varnish, may also be used for the purpose.

A Setting Board for Butterflies.—To make a setting board for butterflies and moths, choose a piece of wood about 1 in. thick; groove it down the centre, and bevel it off towards the sides, so that at the edges the wood is only $\frac{3}{4}$ in. thick. On these bevelled faces entomological cork is glued, and a piece is also glued along the bottom of the groove. Rub down with emery paper when dry. The board may, if desired, be covered with white paper or with white paint. The width of the board and of the groove will depend upon the size of the insect for which it is required. It is usual to have boards of various widths, each long enough to take two or three specimens.

Bleaching Pulp Cane.—If it is required to bleach pulp cane, either soak the material in a solution of chloride of lime, then dip in dilute hydrochloric acid, and afterwards thoroughly steep in running water; or soak it in an acid solution of soda bisulphite, followed by acid and water. It is advisable to experiment first on a small scale.

Straightening and Repolishing a Mahogany Table.—To straighten a round mahogany table that is warped across the centre, first remove the top from the pillar, turn it face downwards, and sponge several times with clean water. Then apply heavy weights or pressure at its highest points for several days, frequently damping the unpolished part. Water should not be allowed to remain on the polished portion. To prevent the top going back again, glue and screw several strengthening bars across. The table should then be washed with common washing soda, a teacupful to 1 gal. of water. Smooth down any roughness with glasspaper, wipe over with raw linseed oil, and clean off with rag. If the top cannot be French polished, it may be improved in appearance by applying, with a camel-hair brush, several coats of spirit varnish made as follows. Orange shellac 1 oz., resin 2 oz., gum benzoin 2 oz., and methylated spirit 1 pt. A rich red tone is gained by adding one pennyworth of Bismarck brown. Shake frequently till dissolved, and carefully strain through muslin before using.

Design for a Divan Chair.—The framing for stuff-over work such as divan chairs needs no elaborate finish, the value and comfort of this class of work being in the upholstering. The back legs are 3 ft. 4 in. long, made from 2-in. square stuff; the turned front legs are 10 in. by 3 in.; side rails and front and back rails, 2-in. square stuff; stuffing rails, 1½-in. stuff; arm scroll A, 1½-in. by 2-in. stuff, mortised into the side rail; width of back, measured inside legs, 1 ft. 10 in.; total width of front of seat, 2 ft. 3 in.; length of seat from front to back, 2 ft. 4 in.; and length of arm board, not including scroll, 19 in. The back rails are tenoned into the back legs, and the arm scroll into the seat rail. All other work is jointed with dowels.



Design for a Divan Chair.

Painting Wire Blinds.—In painting wire blinds, use very thin colour, made with turps and a little gold size; stipple the blind all over directly it is coated, so as to remove the superfluous colour. The space to be gilded should be filled up with dry white-lead mixed with gold size and turps. A little dry whiting dusted on the gauze will prevent the gold leaf sticking.

Hardening Clock Pallets.—Harden each end of the pallet separately; leave the middle soft and, if necessary, bend it. There will then be no necessity for tempering. When tempering steel, it can be either dipped or allowed to cool when the right colour is reached. The result is the same.

Preparing Iron Wire for Tinning.—Immerse the wire in raw spirit (hydrochloric acid) and let it remain till the black scale on the iron is dissolved off. Then pickle the wire for a short time in killed spirit (chloride of zinc), when it will be ready for passing through the molten tin.

Repoussé Work.—In executing repoussé work, first cut out the brass, copper, or other material rather larger than the pattern to be produced. The metal must then be hammered flat, and ground and glazed on the face side. It is then ready for the pattern to be traced on it. The grinding may be done on a stone or an emery wheel. After the pattern has been hammered up, the plate is buffed on a buff, using finest emery and crocus boiled together with mutton suet. This material may be purchased in cakes and bars. The plate is then immersed in strong boiling lye water (soda and water), and thoroughly washed with brushes; this removes all dirt from the crevices. The plate is now ready for polishing, which is done over a dolly running at a very high speed, using crocus with a little rouge. The dolly is a number of circular sheets of calico about 12 in. in diameter, fastened together in the centre.

How to Re-hair a Violin Bow.—In commencing to re-hair a violin bow, cut off the old hair and remove the mountings which held it in position, taking note as to how they are fixed. The wedge H (Figs. 1 and 2) is picked out with the point of a penknife; the metal band G can be slipped off, and then the slide L will come away. The wedge D (Fig. 1) is picked out, and the knot of hair F will then come away. At the head of the bow simply turn up the ends of hair, pick out the wedge D (Fig. 3), and the knot of hair F will come away. The small wedges will probably be suitable for use again. The hair is sold in bundles, each sufficient for one bow, at 6d. to 1s. per bundle. There will probably be a knob of sealing-wax on one end as it comes from the dealer's, which, when broken off, will reveal the ends tied with waxed silk, and cut pretty close to the tieing. In order to keep the ends from slipping out of this tieing, it is usual to sear them in a gas flame or on a red-hot wire, taking particular care not to damage the silk tie, at the same time cementing them together with a little resin. If the wedges have been destroyed in removing them, carefully fit a little piece of wood so that it will secure the hair in the box, as illustrated. The knot made on the end of the hair is now placed in the box at the head of the bow stick (Fig. 3), and fixed with the wooden wedge so that the hair comes away from the box in the form of a flat ribbon. The wedge is sometimes glued in, but this is not altogether desirable. If the wedge is shaped as illustrated, and properly fitted, it will hold quite firmly without glue, and will save trouble when the bow next requires repairing. The wedge must not fit too tightly sideways, or it will be liable to split the box. The hair must be combed through with a small toothed comb, then, coiling it up near the head, steep it for a few minutes in tepid water. Then comb again till it is a straight, flat band, all the hairs running parallel throughout their entire length. The nut B (Fig. 1) must now be set in the middle of its range of motion. Holding the band of hair in the hand over the opening in the nut, allowance must be made for the knot to curl round the wedge in the box, the hair tied with waxed silk, and the ends singed as before. This allowance cannot be measured in any way, but must be judged. Slip the metal band G along the hairs to the top, and let it remain there. Take out the screw C entirely, thus allowing the nut B to come away from the stick; fix the knot of hair into the box in the nut exactly as was done at the other end, and replace the nut on the stick and try it for length. If it has been judged correctly, the hair will be too slack when the nut is at one end of its travel, too tight when at the other, and just right when it is in the middle. If correct, give it a final comb from head to nut, and replace the slide L (Fig. 1), which covers up the wedge box. Replace the metal hoop G and insert the wooden wedge H so as to flatten out the hair against the flat upper side of the hoop, and the job is complete. Fig. 1 shows the nut, Fig. 2 an inside end view of the nut mountings, and Fig. 3 the bow head.

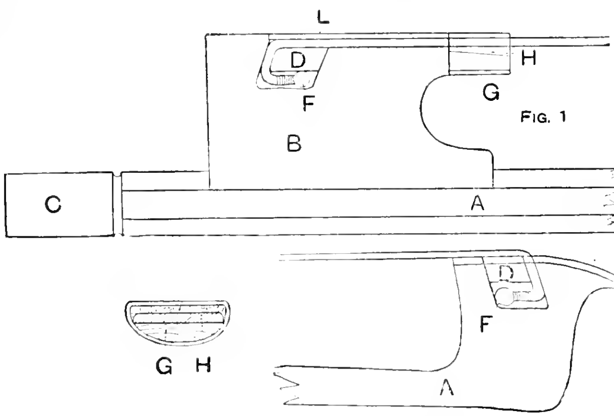


FIG. 2 FIG 3

How to Re-hair a Violin Bow.

"Cuir-bouilli" Leather Work.—For "cuir-bouilli" work untanned hide, not leather, is employed. The former is boiled with water, when it softens and may easily be moulded; tanned leather would not soften sufficiently, nor would it agglomerate when pressed. For ordinary leather work calf, kid, or Russia leather may be used; the material is simply cut to shape, soaked in water, and moulded with special tools.

Filter Beds for Municipal Water Supply.—There is no more satisfactory method of filtering what is already practically pure water than by constructing two or more filters of sand and using them for alternate periods. Each filter (if two be the number) should be large enough to do all the work whilst the other is resting or being cleansed. The rate at which sand filters can be best worked is 50 gal. per square yard per day. The accompanying illustrations show two filters each 9 yd. by 4 yd., which would be able to deal with 18,000 gal. of water every twenty-four hours. The water flows in at A or A', passes downwards through the filter, and finds its way into the main pipe by the outlet B or B'. An escape pipe is provided at C and C'. To cleanse a filter by upward flow the valve V is closed (say filter No. 2 is to be cleansed), the escape at C' is opened, the water is made to enter filter No. 1 at A (Fig. 1), it passes out through B, cannot flow through the valve V, so rises through B', thence through the sand, and out by C'. This flow is allowed to continue for half an hour, or as long as may be found necessary for cleansing the filter; when the water passing through C' is clear, the valve V is opened, and C' is closed. Fig. 2 shows a longitudinal section through the filter. Fig. 3 shows the thicknesses of the layers of sand and gravel in the filter. When there are only two filters, the town supply has to be interrupted during this process of washing; with three or more filters, the pipes can be so arranged that no interruption takes place.

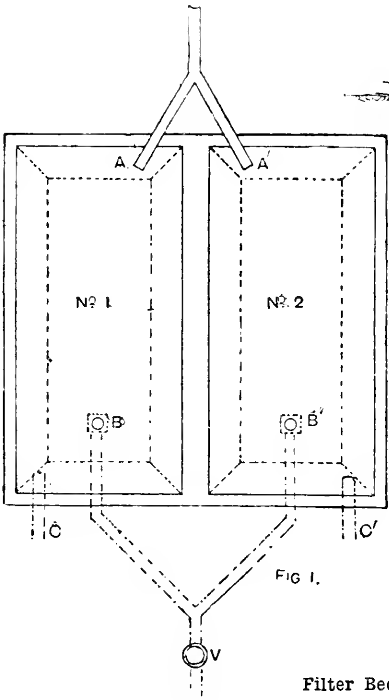


FIG 1.

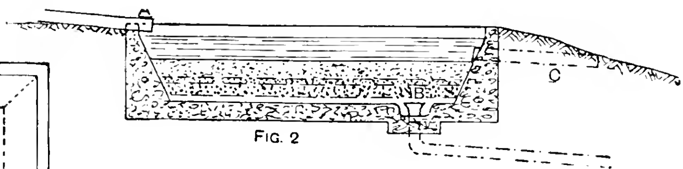


FIG. 2

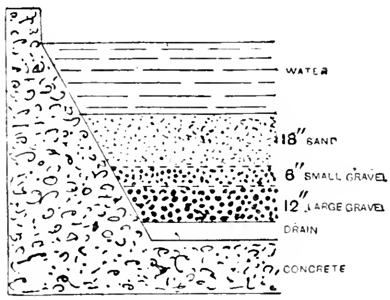


FIG 3

Filter Beds for Municipal Water Supply.

Treatment of Hard Oilstone.—If a Washita stone has got very hard on the surface and will not sharpen, first face down the stone well by sprinkling sharp sand and water on a thick piece of glass, a smooth flagstone or slab of slate, or an iron plate, and rubbing the hard surface on the sand until a new face has been obtained. Dry sand on a piece of board or a sheet of emery paper will answer the purpose, but wet sand makes the best job. Boiling the stone in soda water will soften it to some extent. The proper oil should be used, so as not to let the stone get hard. Vaseline or half lard oil and half paraffin are suitable. Many oilstones are hardened through absorbing the linseed oil used with the white-lead when fixed in the case or for sharpening. The stone should be cemented in the case with glue and red-lead, and the oil should always be wiped off after being used.

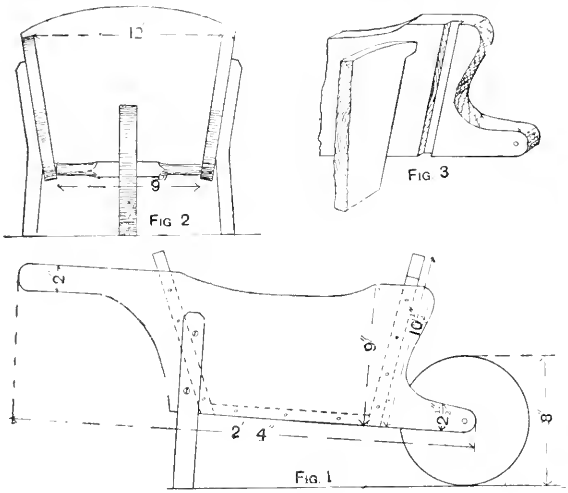
Recipes for Marking Inks.—Here is a recipe for a jet-black marking ink. Dissolve 1 dr. of silver nitrate in a little water, slowly add ammonia until the oxide which first precipitates is redissolved, mix with a little indigo extract or sap green, and add strong gum water to make 1 oz. Write with a quill pen, and afterwards run a hot iron over the writing. For an indelible ink to be applied with a stencil, dissolve asphaltum in coal-tar naphtha or turpentine to form a syrupy solution. Apply with a stiff stencil brush. The following is a very fine indelible marking ink. Add caustic alkali to a saturated solution of cuprous chloride until no further precipitate forms; allow to settle, draw off the liquid, and dissolve the oxide in the smallest quantity of ammonia that will absorb it. Mix with about 6 per cent. of gum dextrine.

Removing a Figure from a Group Photograph.—One of the figures in a group of two in a photograph is sometimes required to be removed. It is done as follows. Mix up a neutral tint with ivory black, ultramarine, crimson lake, and sepia, and add plenty of gum—that is, gum arabic soaked in warm water till it dissolves. Stipple out all the light parts, such as the hands, the face, the lights on the dress, etc., till it matches the middle tints of the background. Then treat the shadows with Chinese white in a like manner, till the two match as nearly as possible. All this should be done by making fine dots close together with the point of the brush. The paint should not be too wet, but wet enough to work easily. Of course, if the photograph is a silver print, the figure could be painted right out by brushing it over with a strong solution of cyanide of potassium or persulphate of ammonia, but the former is the neater plan, and is more under control. Moreover, should it be desired at any time to restore the figure, the paint can be washed off again.

Removing Vaseline Spots from Brown Boots.—To remove a spot of vaseline from a light brown boot, apply a thick solution of white guttapercha, or pure rubber, in bisulphide of carbon. It is the same thing as patching cement, only that it needs to be much thicker. A small bottle of cement evaporated, and the residue added to a bottle newly opened, will answer the purpose. Paint all over and just beyond the stain, and when all the spirit has passed off rub off the guttapercha with a clean rag; if not successful, repeat. The guttapercha that has been rubbed off can be used again.

Fretting a Banjo.—In fretting a banjo, first the position of the bridge must be marked off 9 in. below the base of the handle. Measure the distance between that point and the piece of ebony or ivory glued in at the top of the handle, and divide this distance into eighteen parts; then the position of the first fret, measuring from the ebony just mentioned, will be equal to the length of one of these divisions. From the point thus determined, again measure the distance to the bridge, subdivide it by eighteen, and mark off for the next fret below the first. The total number of frets is sixteen, and the place of each must be found as described, by subdividing the space between the bridge and successive frets, so that every division is proportionally less in length as progress is made. Purchase a set of sixteen fret wires or, if preferred, a single length to be cut as required. Saw the necessary grooves in the handle with a thin tenon saw, taking great care to set them squarely across the fingerboard, and then insert the fret wires. They should fit tightly, and be raised slightly above the plane of the handle.

Child's Wheelbarrow.—Figs. 1, 2, and 3 show the construction and dimensions of a child's wheelbarrow. The sizes can be enlarged or diminished to suit individual taste. Deal boards ⅝ in. thick will be most suitable for the sides and ends. The wood for the wheel should be 1 in. or 1¼ in. thick, and mortised with a square hole for the spindle, shown at Fig. 2; the hole should be about 1¼ in. square. The ends and sides should be housed together as shown at Fig. 3.

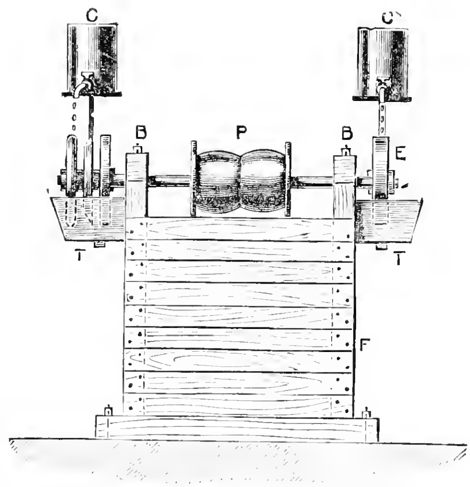


Child's Wheelbarrow.

Simple Collotype Process.—In the process of collotype printing on parchment, as employed in the photo autocopyist process, a sheet of parchment, coated with gelatine and sensitised with bichromate of potash, is exposed behind a reversed negative, the result being that a brownish image is produced in the bichromate salt. The reverse side of the parchment is then exposed in order to bind it and the film together, and the whole is washed for twenty-four hours to free it from the bichromate. It is next stretched on a frame and covered with glycerine and ammonia, which cause it to swell and become tacky in the parts on which the light has acted least. On passing an inked roller over the picture the shadows take up the ink, but the lights or absorbent parts reject it. Thinner ink is applied to give the half tones. A tracing paper mask is then laid over the film, and the printing paper, which must have a good surface, is laid on it and covered with a sheet of felt, and the whole placed in a copying press and well squeezed. After considerable practice 100 copies per hour can be made.

Cleaning a Tiger's Skin.—The following are methods of cleaning a tiger's skin. (1) Moisten bran with hot water and well rub it into the fur with a piece of clean flannel; then with fresh dry bran, well rubbed in with a clean dry flannel. (2) Rub damp whiting (not wet) well into the fur so that it goes down to the actual skin. Leave it till next day, well rub the dry whiting, and remove by shaking and brushing with an ordinary clothes brush. The skin should be placed over the back of a chair and well brushed along the parting thus made, blowing away the dust and whiting at the same time. To brighten up the colours, benzoline should be applied by means of a clothes brush, which should be passed lightly in the way of the fur, not against the fur. (3) Heat in an oven a mixture of equal parts of flour and powdered salt, and while hot thoroughly rub it into the fur. When the whole has been dressed, shake and brush out the mixture as described above. (4) To wash the skin, cut up a bar of soap and dissolve it in about 2 gal. of boiling water. Place the skin upon a table and wet the whole fur with the solution. A gentle rubbing with the hands will loosen most of the dirt. Now dilute about 2 qt. of the solution with 2 gal. of warm water, and continue the washing, the skin still lying upon the table. When the skin is quite clean, remove the soap with plenty of clean water. Then dry it by means of a clean sponge, followed by clean cloths. In this way little of the actual skin will become wet. Now hang it in the shade, and frequently take it down and shake it well, hanging it by a different part each time. Any part that appears to be getting hard should be well rubbed between the hands.

Machine for Grinding Moulding Cutters.—The illustration represents a simple and inexpensive machine for grinding moulding cutters. The frame F is of wood, and fastened to the floor. At B, B are two small bearings, in which a small spindle runs. In the centre at P are two small pulleys, which should revolve at about 700 revolutions per minute. At one end of the spindle is a fine square-faced emery wheel E; at the other end there are three emery wheels—one square-faced, one round, and one bevelled. Over the wheels are water cans C, C, with taps, and the water coming from these is caught in the troughs T, T. With these wheels moulding cutters may be ground and wetted up. It will be an advantage to have a portable rest, or one fixed to the frame of the machine, on which to rest the iron whilst being ground. The iron should be held at an angle of 25° to the face of the cutter for soft wood, and of 40° for hard wood.



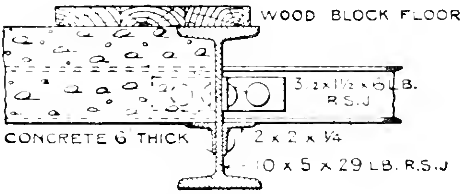
Machine for Grinding Moulding Cutters.

Removing Mulberry Stains from Boat Sail.—To remove mulberry stains from a boat sail, make a strong solution of chloride of lime (bleaching powder), dip the stained parts of the sail in it, and allow to remain for a few minutes. If the stains disappear, wash at once with water only; but if not, then dip in dilute hydrochloric acid (1 part strong acid to 9 parts water), and afterwards thoroughly wash in running water for an hour to remove the excess of acid.

Cooling Shed having Corrugated Iron Roof.—To cool a shed having a corrugated iron span roof, line the under side of the latter with a material which resists the passage of heat through it. Hair felt in sheets ½ in. thick is commonly used. Silicate cotton is better, but not so easy of application. Still further to cool the interior a regular current of air is necessary, and this can only be obtained by an active chimney or a mechanical air propeller. A change of air and the escape of vitiated air can be obtained by having an opening at each end of the shed, one near the ground and one near the roof.

Manufacture of Sodium.—Sodium is made by the Castner process. The materials used are caustic soda and a specially prepared carbide of iron, which is formed by reducing oxide of iron by producer gas, mixing the finely divided iron with pitch, and heating it in closed cylinders. The regenerative furnace contains five egg-shaped retorts each 3 ft. high, and each retort is supported upon a hydraulic lift, by which the retort may be lowered to a cool chamber for cleaning purposes. When the retort is in position it is forced against the cover, which carries a wide pipe for shooting the charge into the retort; this pipe passes up through the furnace, and is closed while the distillation is proceeding. A lateral pipe passes from the retort to a receiver outside the furnace, partly filled with mineral oil, in which the metallic sodium solidifies as fast as it distils. The plant formerly used consisted of a horizontal cylindrical retort, about 3 ft. 6 in. long, connected to the condenser by a straight iron pipe. The materials used are carbonate of soda and finely divided carbon.

Size of Rolled Joists for an Assembly-room Floor.—It is assumed that an assembly-room is to be built over three small shops and that it is proposed to put in rolled steel joists and fill in with concrete. For a clear span of 17 ft. 7 in. the least possible depth of steel joists for an assembly-room floor is 9 in., but a 10-in. by 4½-in. by 30-lb. or 10-in. by 5-in. by 29-lb. section would be much better. These joists may be placed 6 ft. apart, and it would be an advantage if 3½-in. by 1½-in. by 6-lb. joists were placed transversely every 6 ft. between the others, connected by angle brackets and carried by 2-in. by 2-in. by ¼-in. steel angles riveted to web of main girder joist. The concrete should be the best Portland cement to 5 sea-beach gravel, and 6 in. thick. The



Size of Rolled Joists for an Assembly-room Floor.

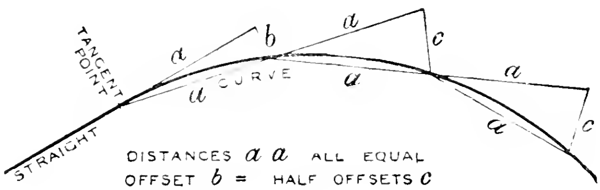
centring should remain undisturbed for three weeks after the concrete is put in, and in the meantime there should be no traffic over it.

Dressing for Fishing Lines.—This is a recipe for a dressing for silk fishing lines. Melt in an iron pot over a slow fire 5 parts of solid paraffin and 1 part of best resin, stirring well together. When partially cooled, dip the line in and draw it out through a piece of sponge or linen to remove superfluous dressing, and lay it on the floor in large coils to dry. The line may then be stretched and polished with a piece of wet linen and a little very fine pumice dust. Another dressing may be made of equal parts of gold size and boiled linseed oil; or copal varnish may be used instead of the gold size. Soak the line in the mixture, then stretch it between two posts or nails for a few days to dry, first wiping off any excess of dressing with a piece of sponge or rag. If gold size is used the line will be ready sooner than if copal is used. Another dressing is made by melting over a water bath 2 oz. of beeswax with ½ pt. of boiled linseed oil. Dip the line in while hot and stretch to dry, as above described. To colour any of these dressings, add a little paint ground in oil.

Making Printers' Rollers.—When a printer's roller is unfit for further use, all the composition is stripped from the iron or wooden core and is carefully washed in hot water, cut into small pieces, and soaked in cold water for about an hour. The composition may be remelted repeatedly, but must be strengthened on each occasion by the addition of treacle and glue. Ordinary roller composition may be bought ready for use at about 8d. per pound; or it may be made by melting 2 lb. of good glue, and then adding 6 lb. of treacle and ¼ lb. of Paris white. These proportions are varied according to temperature and to suit particular kinds of work. In cold weather, and to produce softer rollers, use more treacle; in warm weather, and for harder rollers, use more glue. The glue, which should be clean and brittle, is soaked in water, which when the glue begins to swell is poured off; the glue is then placed in an inner vessel surrounded by an outer vessel holding the water, which must not be allowed to boil. When the glue has been reduced to the consistency of syrup, add the other ingredients, and keep the mixture heated for about an hour, taking care that the glue is not allowed to become too thick. The state of the composition should be tested by placing a little of it on a piece of paper; if, when cool, it is firm to the touch—that is, rubber-like rather than doughy—it is fit to be poured into the mould, which should have been previously warmed and oiled. The core of the roller, before being placed in position in the mould, must be perfectly clean and dry, or the composition will not cling to it. The composition must be poured in at one side of the mould, so that the air may escape at the other side. After the mould has been filled, it should be allowed to remain in a cool place for at least twelve hours, when the roller may be drawn.

Burnishing and Mounting Bromide Print.—When burnishing bromide prints, thoroughly clean a sheet of patent plate glass and dust over it finely powdered French chalk, rubbing it well in all directions; then polish off all the chalk. Some workers prefer to pass the prints through the alum bath after fixing with slight washing before final washing. They are perhaps less likely to stick. If the prints are backed with waterproof paper, this difficulty is removed for a time. Mount the prints dry; as they lie flat owing to their thickness, run a ⅛-in. strip of mountant around the edges only. For this an alcoholic solution of gelatine or rubber solution may be used. It is not advisable to enamel bromide prints, as their character is thereby destroyed.

Setting Out Curved Walls and Kerbing.—For setting out curved walls and kerbing a good eye is required in addition to mechanical aid. Small curves on the ground may be struck of required radius with a scriber and reel of brass wire, or more roughly with a tape line and pointed stick. A wooden template will be found useful in adjusting the work. For large



Setting Out Curved Walls and Kerbing.

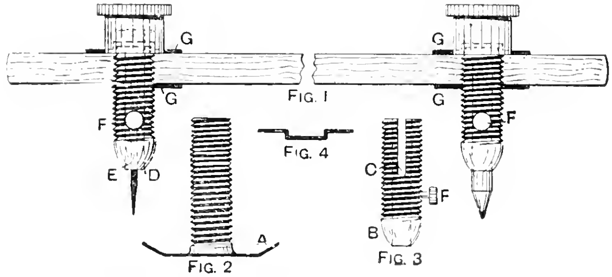
curves, detached points may be marked out by stakes on the ground, as shown in accompanying figure, where $b = \frac{c}{2}$, $c = \frac{a^2}{\text{radius}}$ = feet in offset. In setting out, continue the straight direction past the tangent point to whatever distance is decided upon for length a, then take an offset b as per formula and range through tangent point and offset point to get next offset.

Stuffing and Mounting Fish.—In stuffing and mounting a fresh-water fish, first cover with muslin the best side of the fish, and place it, with the other side up, on a table. Cut along from the head to the tail, and through this long cut remove the flesh of body. After clearing away the eyes and any flesh left round the fins, head, etc., dress with the preservative, which is an arsenical soap composed of 5 parts (by weight) of camphor, 32 parts of white arsenic, 32 parts of white soap, 2 parts of salt of tartar, and 4 parts of chalk. Now pad round the fins, head, etc., with putty, and proceed to stuff the skin by replacing the natural body with an artificial one made of tow, paper, etc., upon a wire foundation, or by well ramming in sawdust, bran, etc., as the sewing up is being done. Now turn the fish over and fasten it temporarily to a piece of board by means of wires left projecting through the cut. Arrange the fins and tail in the desired position and clip them, by means of pins, between pieces of cork. Insert the eyes and close the mouth, using pins and cork, and then leave the whole to dry. Colour carefully to imitate nature, and varnish to represent wetness.

Steaming a Baker's Oven.—For steaming a baker's oven for say half an hour each day, a No. 3 or No. 4 dome-top boiler, as used for hot-water work, but with the inner dome made lower so as to provide a steam chamber, would do; from the top of this a 1-in. steam pipe should be carried into the oven. To feed the boiler, lay on a ½-in. service from the cold-water main, or from a cistern if it is about 30 ft. above. Put a stopcock in this service, and a little water can be let in as required. There must be a good pressure of water in this service, in case it is required to let water in while steam is up. The boiler must have the usual safety valve, water gauge, and emptying tap. A pressure gauge is scarcely needed.

Machinery for Rolling Sheet Lead.—The machinery for rolling lead has to be very powerful. The appliance consists of a long frame, near the centre portion of which are two steel rollers turned by steam or other power. The lead is first cast into a slug of the width of the mill, and a few inches thick. This is run on loose rollers, fitted in the frame, up to the steel rollers, between which it is passed, the latter rollers being held a certain distance apart by means of adjusting screws. The slug is passed to and fro between the rollers, which are brought closer together after each passage, until the lead is reduced to about ¼ in. to ⅜ in. in thickness. The sheet is then folded and again passed between the rollers; for very thin sheets it is again folded and again passed through until the desired thickness is attained. As the tenacity of lead is very low, very thin sheets cannot be made singly. The price of milled lead is not very much more than that of pig lead, and it can be bought for considerably less than it can be manufactured on a small scale.

Making Trammel Heads from Dunlop Tyre Valves.—A serviceable pair of trammel heads for drawing-office work may be made from old or disused Dunlop valves. Remove the cap and nuts, cut off the flange shown at A (Fig. 2) with a file or a hack saw, and file the end to the shape shown at B (Fig. 3). Drill a ⅛-in. hole at C (Fig. 3) right through each valve, and with a hack saw carefully cut out the slot (Fig. 3) ⅞ in. long by a full ⅛ in. wide; file up smooth with a ward file. A piece of brass is fitted tightly in the hole in one of the valves, as shown by dotted lines D (Fig. 1), and soldered in place: the shank of an ordinary brass screw suits admirably. It is then drilled with a $\frac{1}{16}$-in. hole, as at E (Fig. 1), to take the needle point, for which a piece of an upholstering needle, or the shank portion of a very fine drill ground to a point, can be used. Now get two small milled-head screws F (Figs. 1 and 3), such as are used on gas brackets to keep the globe in place, and drill and tap a hole in each head to receive them. Take four pieces of watch spring G about 1½ in. long, and bend them to the shape shown at Fig. 4; these prevent the heads cutting the beam, and at the same time hold them in position when they are being moved along the latter. The pencils supplied with most diaries and pocket-books fit the heads nicely. For the beam, a piece of black walnut of any suitable length, accurately planed to $\frac{7}{16}$ in. wide by ⅛ in. thick and polished, is best. An ordinary compass pen may be made to fit into the end of the head by unscrewing it from the handle and filing it a little. Slide the heads on the beam, first placing the pieces of watch spring in the slots, the lower ones with the bend downwards and the upper ones with the bend upwards (see Fig. 1), and screw on the caps. Instead of cutting slots in the heads, holes may be drilled and a piece of steel wire used for the beam; but this does not answer so well as a flat piece of wood.



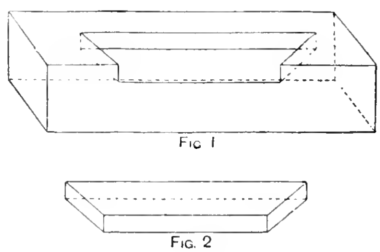
Trammel Heads made from Dunlop Tyre Valves.

Recipes for Stencil Inks.—The following is the recipe for a perfectly dead black stencil ink which is insoluble in water. Dissolve 1 oz. of shellac in ½ pt. of methylated spirit of wine, filter it through a layer of chalk, and then add lampblack. It will make the brush rather hard, but that can be softened by soaking in the ink before use. For another ink, boil ½ lb. logwood chips for ten to fifteen minutes in 2 qt. of soft water; then add 1 drachm potassium bichromate, and boil up again for ten minutes. Add, when cold, some gum-water; stir, and shake well before using. A simple recipe is, incorporate lampblack with gold size, not too thin, and use sparingly. The above inks are suitable for marking on metal. The following is the composition of the ink used for marking sacks. Ordinary printer's ink, to which a little terebine has been added, may be used; or ordinary oil paint will answer the same purpose if slightly thinned. Stencilling is performed by a dabbing motion of a stiff-haired brush, lightly charged with paint or ink, over the perforations in the stencil plate. Special stencil ink may be prepared by incorporating any mineral colour (lampblack for black ink, with Venetian red for red ink) with gold size and, perhaps, a little boiled oil. Another method is to dissolve 1 oz. of shellac in ½ pt. of methylated spirit, adding to this any dry colour as required. Asphaltum, dissolved in naphtha or benzoline, may also be used. For cake stencil ink, grind lampblack and gum arabic down on a slab or in a mortar, make into a paste with water, and allow to dry.

Imitation Sandstone.—For artificial rock, Portland cement may be made to look like grey sandstone by mixing 3 parts of crushed grey sandstone with 1 part of cement; for red, use the same quantity of red sandstone. If the coloured sandstones are not obtainable, the cement may be coloured grey with lampblack, or a warm grey with umber and a little lampblack. The cement may be coloured red with red oxide of iron, toned, if necessary, with a little umber.

Furnace for Casting Aluminium.—A furnace for melting aluminium may be built like a brassfounder's furnace; the interior should be square with loose fire-bars, an ashpit having a grating in front, and a chimney. It must be built of fireclay bricks, puddled with fireclay. The top is covered with a fireclay slab, which may be removed for inserting or withdrawing a crucible or for stoking. The fuel used is ironfounders' coke.

How to Repair Worn Stone Steps.—By one method of repairing worn stone steps, the worn part is marked out with a dovetail (see Fig. 1), to which the stone is then hewn out from 2 in. to 3 in. deep, according to the amount of wear. A piece of stone (Fig. 2) is then prepared and fixed in the step with good lime or cement, and the job is then complete.



Repairing Worn Stone Steps.

Damp Walls in Basement.—It is desired to overcome dampness in the walls of a rather old house which has no damp course and whose basement floor, 5 ft. below the level of the street, is paved with slate 2 in. thick. A damp-proof course should be inserted about 6 in. above the floor level. The flooring should be taken up and about 5 in. of earth excavated. On the new level a bed of concrete about 4½ in. thick (say, in the proportions of 6 to 1) should be laid, and this should be covered with ½ in. of natural rock asphalt, which should be carried up the walls as a skirting to the level of the damp-proof course. On this the flooring of slate slabs may be relaid; or, if preferred, the excavation may be only 2½ in., the concrete laid, and the asphalt used as the finished floor. If the floors were of timber they should be taken up, the earth excavated to the level of the footings, a similar bed of concrete and asphalt with asphalt skirtings laid, the space below the boards thoroughly ventilated, and the wooden floor refixed, care being taken not to injure the asphalt skirting. This method is somewhat expensive, but is effectual if the work is properly done.

Scoring Granite Pavement.—The work of scoring a granite pavement should be done with a heavy short-handled hammer and a mason's chisel made from steel of about 1¼ in. diameter drawn down to a flat point ¼ in. broad. This is known as a punch. If continuous lines are to be scored across the setts, a string should be stretched between iron pins as a guide; but roughening the setts by punching indentations about 1½ in. apart should serve just as well as scoring lines across.

Cement for Aquarium.—To make a cement for fixing the glass of an aquarium melt together 2 parts of pitch and 1 part of guttapercha; apply to the joints hot, and slightly warm the glasses before pressing them in position. The seams may be neatly finished on the outside by slightly heating a small poker and running it along the cement. Another cement can be made by mixing gold size to a paste with zinc oxide.

Composition Rollers for Branding Sacks.—To make composition rollers for branding sacks, soak until soft in sufficient water to cover it 1 lb. of glue; then melt down by a gentle heat and stir in 4 lb. of treacle. The rollers are cast in cylindrical tinplate moulds with a cylindrical core of wood placed in the centre. In hot weather the material should be made stiffer by increasing the quantity of glue to 1½ lb. The material will better withstand the heat if the rollers are dipped for a short time in a solution of bichromate of potash and then exposed to light; an insoluble film is by this means produced on the surface.

How to Make a Pigeon Cote.—Fig. 1 is a front view, and Fig. 2 a section, of a pigeon cote. Three nests may be placed in each of the three openings. A piece of iron about ⅛ in. thick bent to the shape of the hole over the drop-board is held inside by a hook on which it swings loose, thus allowing anything to go in the cote but not to come out. The piece A (Fig. 1) should be 1½ in. wide by ¾ in. thick, to hold the door. Two 3-in. hinges are required for the door, and a lock. The piece A should be sunk into the top and bottom to fix it. Bore twelve holes in the wood to let in fresh air, and a small window may be fixed in the side for light, if required. The roof should slant, as shown. A hole should be cut in the boards for the entry of the pigeons, and a drop-board about 10 in. long by 6½ in. wide should project from the hole. At B (Fig. 2) two boards should project about 12 in. inside at the back of the cote; also at the bottom, as at C, for the nests, etc. The wood required for this cote is 97½ ft. of 6-in. by ¾-in. stuff. The boards should be tongued and grooved to hold together better. Two strips of wood for each side will be required inside to hold the boards. A coat of tar, etc., could be given to make the cote watertight. The total height is 4 ft. 3 in., length 2 ft., and width 3 ft.

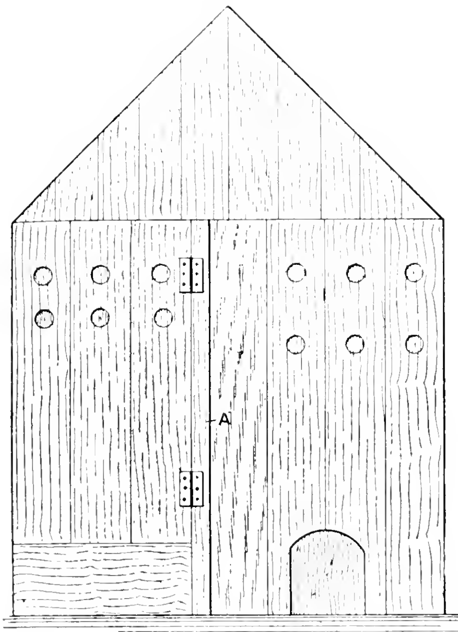


Fig. 1

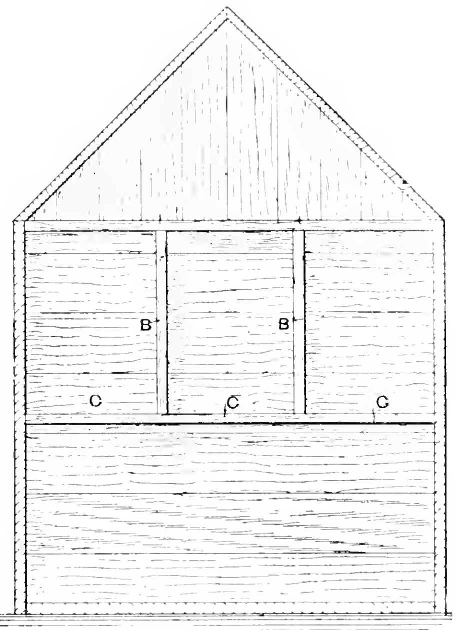


Fig. 2

How to Make a Pigeon Cote.

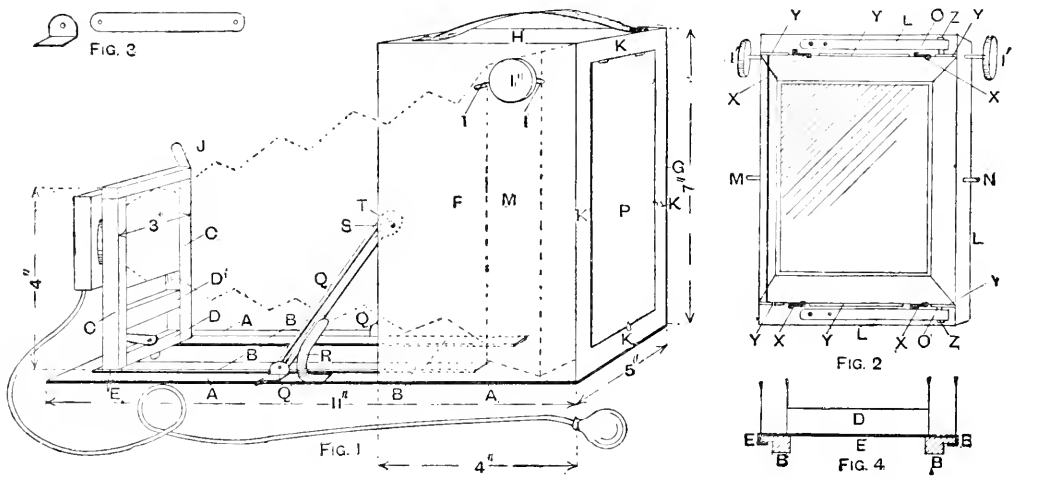
Hints on Repolishing Furniture.—Repolishing, though practically the same as French polishing, calls for more tact if the article is dirt-begrimed, broken, or bruised, and entirely different in colour from what it was when first finished. Assuming that such an article is to be repolished, it should first be cleansed. For this purpose, dissolve a teacupful of common washing soda in 1 gal. of warm water, and well rub the article, using, if necessary, a little pumice-stone powder or powdered Bath brick, and afterwards wiping quite dry. Any necessary repairs should be attended to, doors unhinged, and all carvings, knobs, brass fittings, etc., removed. Bruises in the wood may be generally drawn up level by pressing an old flat file, made black-hot, on several thicknesses of wet brown paper placed on the wood. A bad bruise should be scraped out with a cabinet-maker's scraper and filled up with a mixture of equal parts of resin and beeswax melted together and coloured with venetian red or umber, to match the wood. Having made good all defects, wipe over with a rag moistened with linseed oil, which will cause the old and faded work to appear darker where the polish is removed; on comparatively new work a light place will show. This difference in colour requires to be matched by the aid of stains, dry colours, or dyed polish; light mahogany places are darkened by wiping over with strong soda water, lime water, or solutions of bichromate of potash, and light places in walnut by wiping over with one pennyworth of asphaltum dissolved in ½ pt. of turps. If the faded polish or light places are not matched by the above means, body the portion up by passing the polish pad over it several times to prevent the grain rising; then colour up by mixing suitable pigments in 1 part polish and 3 parts spirit. For walnut, add dry brown umber or vandyke brown with a little black, and apply with a small tuft of wadding or a camel-hair brush. A wavy appearance may be obtained by a tremulous movement of the hand, and a mottled appearance by gently dabbing with a badger softener or a soft dusting brush, such as a sash tool, while wet. If rosewood, mix a little red stain and black, and after allowing the stain to set for a few minutes, smooth down with fine worn glasspaper, and apply a thin coat of spirit varnish. The polishing ingredients are the same as for new work, but thinner. A tinge of red stain in the polish improves walnut, mahogany, and rosewood; but if for the purpose of matching any particular portion, a strong colour should be used on the polishing pad, finishing off with clean polish on another rubber. All carved portions, mouldings, and parts difficult to finish with a pad should be given an even coat of varnish. Many articles may be improved by simply applying one or more coats of good quality spirit varnish, for which the following is a recipe. Shellac, 1 oz.; sandarach, 4 oz.; mastic, ½ oz.; Venice turpentine, 1 oz.; camphor, 10 gr.; oil of turpentine, ½ oz.; and methylated spirit, 1 pt. Shake well over a gentle heat and carefully strain through muslin before using, and apply with a camel-hair brush in a fairly hot room. For common goods, such as kitchen furniture, the following will suffice. Shellac, 4 oz.; resin, 2 oz.; benzoin, 2 oz.; and methylated spirit, 1 pt. To make a red stain, dissolve one pennyworth of Bismarck brown in ½ pt. of spirit. A few drops added to polish or varnish will give a reddish tinge.

Construction of Folding Hand Camera.—Instructions on making a quarterplate folding hand camera are here given. From ¼-in. mahogany cut a piece 11 in. by 5 in. (A, Fig. 1). The rails B B (Fig. 1), shown in section in Fig. 4, should be fitted as shown ½ in. from the front and 1½ in. from the back. Now cut the two posts C C ¾ in. square and 4 in. long, and join with the cross-pieces D and D^1. Cut and bend the plate E (Fig. 4) to fit the rails B; see that it runs smoothly, then screw into D. Now cut the board A (Fig. 1) in two pieces straight across 4 in. from the back, and hinge together again underneath. Cut three pieces F, G, and H; F is 7 in. by 4 in., G 7 in. by 3 in., and H 4 in. by 4½ in. In F and G cut the two slots I (the arc being formed with a radius of M) and join all together with A and K, leaving an opening between K and G for the insertion of the dark slide. Next construct a framework L (Fig. 2) 6 in. by 4 in., canting the top and bottom slightly to permit of swing. Fit in this another frame (to which the bellows is fastened) ½ in. wide at the sides and 1 in. at the top and bottom. Pivot the sides of the swing frame to F and G at M and N, and fix the thumbscrews I and I^1. Having got this to work smoothly, remove the frame and form two tongues Y Y, 5¼ in. apart, running from F to G. These form guides or stops for position of dark slide. Now cut two thin brass springs O and screw to the sides of the frame above and below the tongues. Next make the focussing screen 5¼ in. by 3⅞ in., with ⅛ in. rebate for ground glass 4¼ in. by 3¼ in., giving a sight of 4 in. by 3 in. At top and bottom of the right-hand end place a screw Z so that it slips under O. Cut four sets of brass joints (as shown in Fig. 3) for attaching the focussing screen to the swing frame. Next fit the door P (Fig. 1) for focussing. Construct two joints Q with springs R, and fit them to the sides of F and G (inside) and to the bottom A. On pulling down the front the spring R forces the side stays up so that the pin S passes into the slot T. The rising front carrying the flange consists of a square of wood, with opening for lens, fitting between the front posts and fastened to a rim of brass at the top through which passes a coarse thread screw worked by a lever J, which, biting against the front post, holds all tightly together in any position. A similar screw fastens the front posts after focussing.

Washing Photographic Printing-out-paper.—Ordinary tap water, which is generally more or less hard, is used for the preliminary washing of P.O.P. The chlorides, etc., combine with the free silver, which is thus removed. Trouble may arise with extremely hard water, particularly with gelatine papers. The chlorides and sulphates have been found to form compounds in the film that are not readily soluble and are not removed in the hypo bath or in the final washing if gold has been deposited on them. In such cases the whites of the picture usually turn yellow. M. Scholzig has suggested the following experiments. Wash two pieces of unexposed paper in four changes of tap water for a total period of ten minutes. Let one piece soak for another ten minutes in a new toning bath. Place both pieces in the hypo bath; wash and dry. Next soak them both in water containing a few drops of ammonium sulphide. The untoned piece of paper will be found to have kept its colour, but the toned piece will have yellowed considerably owing to the formation of sulphide of silver. Thus the theory has been propounded that the gold forms a sort of casing around the injurious compounds and keeps them from being dissolved out. As the preliminary washing is dispensed with when the combined bath is used, toning by this method offers a possible way out of the difficulty where the water is very hard; but with the combined bath the results are not permanent.

Removing Porcelain Letters from Glass.—To remove porcelain letters from glass, well clean the edges of the letters with the point of the blade of a pocket-knife. Then insert a very thin dinner-knife between the letter and the glass and work it carefully upwards; the joint will then break and the letters fall off.

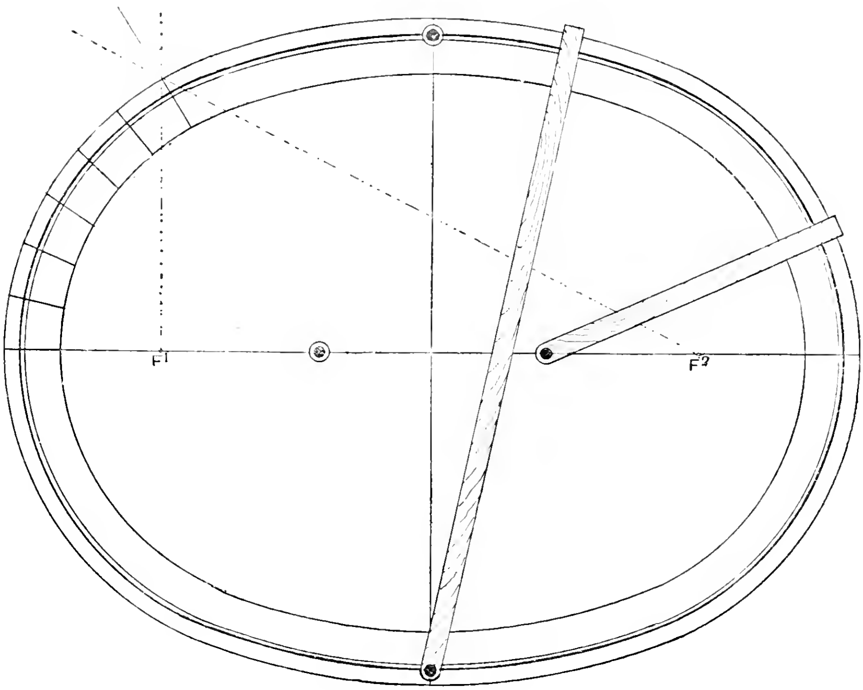
How to Make Copying Inks.—Copying inks may be made by adding a small quantity of alum to an extract of logwood. To this is added table salt or sugar and glycerine. The inks so obtained are purple when first used, and darken gradually on the paper. The copies taken from them darken still more slowly. Violet writing ink may be converted into copying ink by the addition of glycerine in the proportion of about 3 parts of the latter to 4 parts of the violet ink. If a quantity of glycerine slightly less than the foregoing be used, the ink will copy within a quarter of an hour after writing. An ink which will yield one or two copies by hand pressure may be made by mixing, say, 1 pt. of glycerine in 3 pt. of jet-black writing ink. The following is a recipe that has been recommended. Place 2 dr. of crystallised carbonate of soda and 1 oz. of extract of logwood in a porcelain receiver with 8 oz. of distilled water. Heat this until the solution reaches a deep red colour and everything is quite dissolved. Then remove it from the fire and stir in 1 oz. of glycerine, 15 gr. of neutral chromate of potash, and 2 dr. of finely pulverised gum arabic, each of the latter dissolved in a little water. This is another recipe. Take 4 gal. of soft water (preferably rain water), and add gum arabic, clean copperas, and brown sugar, using of each ¼ lb. (not more), and 1 lb. of powdered nutgalls. Allow this to stand for two weeks, shaking occasionally, then strain. This ink will not fade on exposure to the atmosphere. A simple method of making copying ink is to evaporate 1 oz. of ordinary ink to a quarter of its bulk, and dissolve in it 20 gr. of powdered sugar. Another recipe is to boil together ½ lb. logwood extract, 2 oz. of alum, 4 dr. sulphate of copper, 4 dr. sulphate of iron, 1 oz. of sugar, and 4 parts of water, and filter through flannel. Add a solution of 4 dr. of neutral chromate of potash in 4 oz. of water, and a solution of 2 oz. of chemic blue in 2 oz. of glycerine. For red copying ink, dissolve 5 parts of logwood extract in 150 parts of distilled water without the aid of heat; add ⅜ part of chromate of potassium, and set aside for twenty-four hours, and then add a solution of ⅜ part oxalic acid, 4 parts oxalate of ammonium, and 8 parts of sulphate of aluminium in 10 parts of distilled water, and again set aside for twenty-four hours. Boil in a copper vessel, and add 10 parts of vinegar. In a fortnight's time decant and bottle.



Construction of Folding Hand Camera.

Value of White Mica.—White mica or muscovite is valuable, especially if in large pieces, which cleave easily into thin plates. It is used for chimneys for incandescent gas lights and Davy lamps, for smoke preventers or hoods for lamps and gas burners; also in place of glass in the fronts of gas stoves, etc.; and in some countries it is used in place of glass for windows. The rough stuff is ground up and used as a paint, and the fine scaly kinds are coloured and used in place of bronze colours. The black mica, or biotite, is of no value. Sometimes black talc is called black mica. In addition to the uses above mentioned, mica is put into room ventilators, and it is very largely employed in electrical machinery as a non-conductor.

Running an Oval Frame in Cement.—The best method of running an oval frame, 18in. by 11in., in Keene's cement, would be to use trammels and zinc templates, as shown in the figure, which is drawn proportionate to the required size; or the frame might be made of wood and bent to the required shape; or a series of divisions might be made on the oval by drawing lines perpendicular to the curve (as shown on the diagram) and cutting similar pieces from a straight strip of moulding and joining these together, though this would be a somewhat elaborate method.



Running an Oval Frame in Cement

Galvanising Wire Articles.—When galvanising small wire articles, keep the surface of the molten zinc well covered with sal-ammoniac, and heat the metal well above its fusing point. Then immerse the articles and move them in the metal until the zinc appears to be flowing freely upon the wire; withdraw and strike lightly with a stick to jar off superfluous metal.

French Polishing in Self Colours.—Brackets, tables for bric-a-brac, picture frames, etc., are often more attractive when finished in self colours with either a bright or dull finish, and a judicious addition of gold and flower decoration, than if finished in the natural tones left by the polish rubber or spirit varnish. Most of the enamel paints now sold in tins have an oil varnish basis, which means that at least twenty-four hours should elapse between each coat; and though some of them have remarkable covering properties, it is sometimes necessary to apply at least three coats in order to gain a good solid body, and if any portion is afterwards to be gilded it should be allowed to stand several days to harden thoroughly before this is attempted. Spirit varnish enamels dry much more quickly, and to those conversant with the art of French polishing come as a welcome change, giving a pleasing finish with a minimum of trouble, and, moreover, present a surface more readily adapted for the purpose of decorative ornament, whether gilding, transfer decoration, or hand painting. These enamels are made by carefully blending dry colour in spirit varnish, a dead or semi-lustrous finish being gained by thinning out the last coat with methylated spirit by the addition of a little linseed oil, or by dulling with finest grade pumice powder or flour emery. A plan sometimes adopted is to mix the colour required with about equal parts of polish and spirit, coat after coat being laid on till a solid body of colour appears. Two, three, or more distinctive colours may be laid on the article; for instance, Japanese boxes, plaques, etc., will be seen in various tones underneath the decorations. When the colours—which should be laid on with camel-hair brushes—are dry, the surface should be smoothed down with finest grade glasspaper, and a coat of clear spirit varnish applied: and this, when dry, will give a superior enamel finish if carefully polished. Picture frames are especially suited to this mode of treatment. The pictures and glass being removed, the frames should be well dusted, and suitable pigments mixed in half polish and half spirit. A bronze green, mixed as advised, gives a finish neither very bright nor yet quite dull; gilt slips being put in give a green and gold finish. If a bright finish is desired on such a foundation a transparent or white hard varnish is advised. Common brown hard spirit is apt to alter the colour, but more pleasing results are gained by leaving the frames semi-dull, a small quantity of varnish being added to the enamel for that purpose.

Artificial Stone Cement.—The following cement, which does not require to be kiln-dried, may be used with pedestals, etc., out of doors. The materials required are silicate of soda, or water-glass; carbonate of lime; chloride of calcium; and quartz, or pure flint sand: this, if from the sea shore, should be well washed and sifted; if Bedfordshire sand, sift it to get uniformity, and wash it once. Take 1 gal. of silicate of soda and 1 bushel of mixture of flint sand and a small quantity of carbonate of lime; mix mechanically, and pour into the mould and then pour over the mixture the chloride of calcium. Another cement is washed silicious sand 3 parts, shellac 1 part. Melt the shellac, and mould into the sand while warm.

Making Glass-fronted Hanging Cupboard.—Fig. 1 is an elevation of a small glass-fronted cupboard suitable for hanging on a wall. The top is 1¼ in thick, the bottom 1 in. thick, and the sides and back ¾ in. thick. The sash forming the door is ¾ in. thick, finished size. The top is rebated and moulded, the moulding being returned along the ends to form a small cornice (see Figs. 2 and 5); the bottom is prepared in a similar manner (see Fig. 3). The ends are rebated front and back (see Fig. 4). Fig. 5 shows how the end is fixed to the top and bottom, whilst Fig. 6 gives a

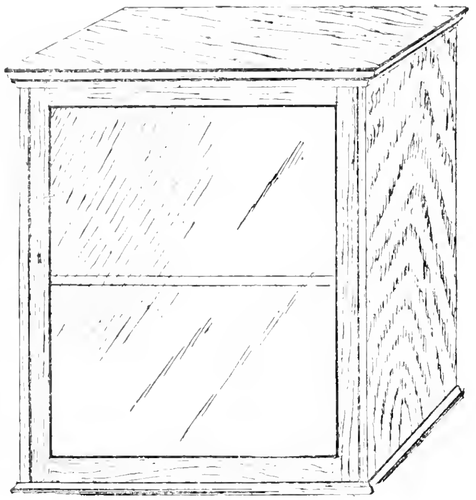
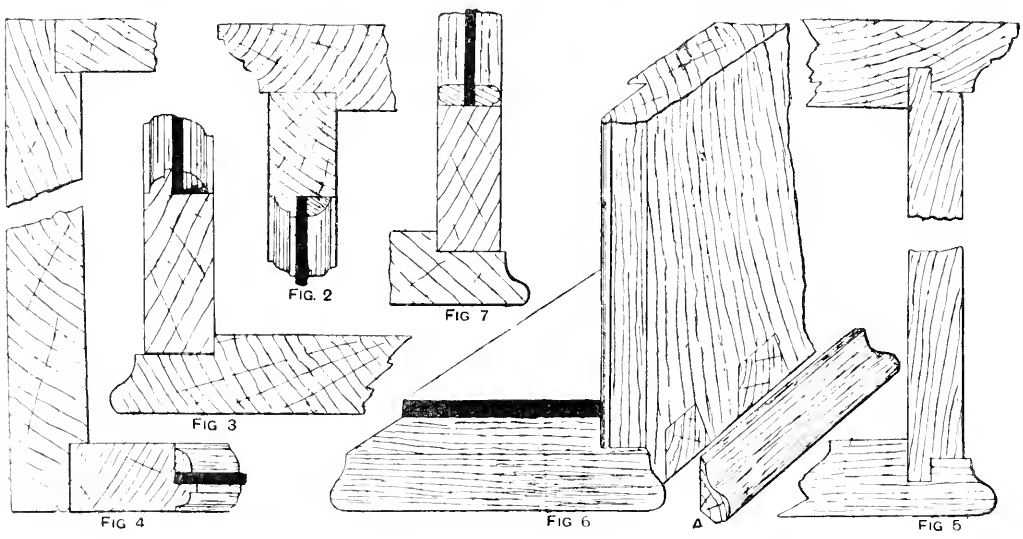


FIG I



Glass-fronted Hanging Cupboard.

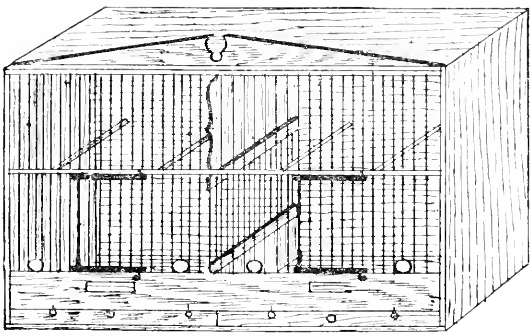
better method of fixing the bottom to the end or side by means of dovetails, the pins being cut on the bottom. A loose piece of moulding is then planted on to cover the dovetailing, and the sash is mortised and tenoned together. If desired, a chamfer may take the place of the ovolo moulding on the stiles and rails, or the sash may be made square and a bead mitred round and fixed with panel pins, as shown in Fig. 7. The sash is hinged with brass butts, and a straight cupboard lock fixed on the left-hand stiles, the keyhole only requiring to be cut, and a small thread escutcheon let in on the face of the stile. The middle shelf is fixed on movable fillets.

Arrangement of Small Turret Clock.—The following specification is for a small turret clock which will strike on a 1¼-cwt. bell. Going barrel, 6 in. in diameter and 16 in. long; main wheel, 10 in. in diameter, one hundred and twenty teeth. The hour wheel has forty teeth, is 3⅓ in. in diameter, and runs with the main wheel; the second wheel, driven also from the main wheel, has a pinion of ten leaves, is 8 in. in diameter, and has one hundred and twenty teeth; the 'scape wheel (dead beat) is driven by the second wheel, has a pinion of eight leaves, is 4½ in. in diameter, and has thirty teeth; striking barrel, 7 in. in diameter, 16 in. long; main wheel, eighty teeth, diameter 12 in.; second wheel (carries eight cams for lifting the striking hammer), 8 in. diameter, eighty teeth, pinion of twenty leaves; third wheel (carries a cam upon which the striking lever rests), 6 in. diameter, eighty teeth, pinion of ten leaves; fly (carries the locking arm), pinion of ten leaves. The locking plate or count wheel is mounted on a stud outside the frame, and is driven by a pinion of eight leaves fixed to the axis of the cam wheel or second wheel. The locking-plate wheel has seventy-eight teeth. The fly has two vanes, each 8 in. by 4 in., the centres of which are 12 in. from the axis. The main wheel of the going train revolves once in three hours; the second wheel once in fifteen minutes; the 'scape wheel once in one minute. The cylindrical bob of the seconds pendulum is of cast iron, weighing about 70 lb. The going weight will probably be about ½ cwt. or a little more, falling about 24 ft. on a double line for a four days' run. The striking weight should be about 1½ cwt., falling about 20 ft. on a double line for a four days' run. The clock can be made to go for a week by increasing the weights, putting them on triple lines, and giving about a 30-ft. fall. The frame should be A-shaped, with the going train up the right-hand side and the striking train up the left. The pendulum should hang in the middle of the frame from the top and swing between the barrels. The back 'scape pivot must be held by a cock to clear the pendulum rod. The arbors of the wheels run in gunmetal bushes screwed on to the sides of the frame, and each is detachable separately. The striking pinion, cams, barrels, main wheels, and second wheel may be of cast iron; all other wheels should be gunmetal, and all other pinions, lanterns. The bell hammer should weigh about 3 lb. The pendulum, if not compensated, should have a deal rod, round, 1 in. thick. The wood minute hand is poised by a short outside counterpoise, and the hour hand by an inside weight.

Stockholm Tar and Swedish Pitch.—Stockholm tar is obtained during the manufacture of charcoal from pine wood. It is a good preservative for woodwork, being better than coal tar for the purpose. It can be thinned with creosote oil or coal-tar naphtha, or with wood spirit. Swedish pitch may be melted and the tar stirred into it for thickening purposes. It is, perhaps, best to apply the tar hot, because heat expands the cells of the wood, and the subsequent contraction causes the tar to be drawn into the wood. Swedish pitch is simply the tar heated until the liquid volatile portions have distilled over.

Black Enamel for Ferrotype Plates.—To make the black enamel for ferrotype plates, mix together amber 90 parts, black resin 60 parts, spirit of turpentine 15 parts, and painter's varnish 45 parts, and add sufficient lamp-black to give the desired blackness. The varnish is contained in an upright bath and the plates in fairly large sizes dipped and afterwards cut up. Then coat with collodion and sensitise as usual.

Breeding Cage for Small Birds.—The illustration shows a breeding and flight cage, which may have a mahogany front and zinc drawers. The cage may be 33 in. long, 14 in. deep by 11 in. wide, or it may be 28 in. long, 15 in. deep by 11 in. wide. The cage is divided into two compartments by slides running from front to back, but when pairing or feeding these slides should be replaced by wired partitions, the wires being ¾ in. apart to permit the birds to put their heads between them easily. A four-compartment cage made on the above plan might be 31 in. long, 25 in. deep by 11 in. high. It is, perhaps, rather low, but it answers for Norwich birds. The lower part could be used, when necessary, as a flight cage by removing the partitions. False bottoms must be provided with a ¼-in. beading all round to keep the sand, etc., from falling off. Zinc can be used for the seed drawers, but the water should not be kept in a zinc vessel, as this metal is said to be injurious. The cage wires should be ½ in. apart, but the partition wires should be ¾ in. apart, so that the young birds may be easily fed. The bottom stay should be 3½ in. high, with the lower inch cut off to form the front of the false bottom. Fix a

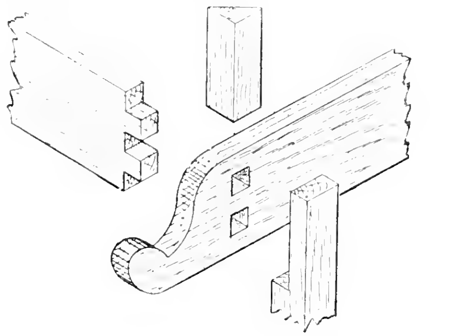


Breeding Cage for Small Birds.

perch parallel with the bottom stay about 2 in. behind it and 1½ in. lower than the top of the stay. This forms a feeding-perch. A perch should also be fixed on each side of the cross-piece for the young birds to stand upon while being fed. An egg drawer should be provided for each compartment. As cleanliness is an important consideration, the front should be removable, which is easily arranged by forming a framework of wood ½ in. square just large enough to fit inside the front. In this framework build the front, and fasten it to the body with a couple of small brass hinges at the top. A small thumbscrew on each side towards the bottom should enter from the outside into the front and thus keep all tight. On raising the front, the perches come out and the whole of the inside of the cage is easily reached at cleaning time. Whitewash is frequently used for the interior of the cage, but blue enamel is better, as its smooth, hard surface affords no protection to vermin, and it is easily cleaned.

Recipes for Red Inks.—(1) To make bright red ink, over 8 oz. of bruised cochineal pour 1 gal. of boiling water, and let it stand. Now boil 8 oz. of Brazil wood in ½ gal. of soft water for half an hour, and in two days' time mix both together. Dissolve 2 oz. arabic in 1 qt. of water, and when cold add one solution to the other and stir well. Cork the mixture up, and in seven days strain through muslin and bottle. (2) Pour 2 parts of 90 per cent. alcohol over ⅔ part of finely rubbed fuchsine, and dissolve by gently heating. Dissolve 1 part of gum arabic in 20 parts of water, boil, and then, whilst stirring, add the fuchsine solution in a thin jet. (3) Dissolve 30 gr. of No. 40 carmine in 1 dr. of ammonia, and add 6 gr. of acacia and sufficient water to make 1 oz. The tint is regulated by the amount of water added. (4) Grind 1 part carmine with 15 parts acetate ammonia and 15 parts water. This is allowed to stand for some time, strained, and then thickened with a few drops of dissolved white sugar. (5) Dissolve ½ dr. of powdered drop lake and 18 gr. of powdered gum arabic in 3 oz. of ammonia water. (6) Dissolve ½ oz. of aniline red in 5 oz. of strong alcohol; let it stand in a covered vessel for about three hours, then add 35 oz. of distilled water. Heat gently for some hours until the odour of alcohol is no longer perceptible. Add to the liquor 8 oz. of distilled water in which 2 oz. of gum has been previously dissolved. (7) Aniline red, 20 parts; gluten or gum, 100 parts; water 1,000 parts; and acetic acid, 100 parts. The process is practically the same as with (6). (8) Dissolve 1 oz. of anile crimson in 1 gal. of water. (9) For red cochineal ink, rub together powdered cochineal, ½ oz.; carbonate of soda, 1 oz.; distilled water, 13 oz. Mix these in a large mortar capable of holding 3 pt. or 4 pt., and stir frequently during two days; then add cream of tartar ½ oz., alum ½ oz. Warm gently, and stir until all the carbonic acid has passed away. Add gum arabic ½ oz., alcohol ½ oz. Filter, and make up the solution to 15 oz. with distilled water. The ink should be at once bottled, and kept well corked. (10) Rub 1 part of carmine with 12½ parts of liquid water-glass. Dilute with 112½ parts of rain water, allow to stand for a few days, and pour off. (11) Buchner's carmine ink is made by dissolving together 12 gr. of pure carmine, or ½ dr. powdered drop lake, and 3 oz. of aqua-ammonia. Add to this 20 gr. powdered gum.

Making Table Framework.—The accompanying sketch illustrates an easy method of making the framework of a table. The front and back are cut out with the ends shown, in one piece. The ends are mortised into the back and front, and the legs, which should be about 2 in. square, are halved at the top and glued to the



Making Table Framework.

sides, with two or three screws put in from inside the frame. After the legs are fixed, the blocks are glued in the corners.

Crystoleum Painting.—Instructions on making crystoleum paintings are here given. Procure a pair of convex cabinet-size crystoleum glasses, costing about 9d., from any artists' colourman, together with sable brushes and the usual oil colours, megilp, palette knife, etc. Trim the photograph until it is a little smaller than the glass, which, after cleaning, should be well brushed over on the concave side with starch paste. Press the wetted photograph into close contact, and work out the creases by rubbing from the centre to the margins with the bowl of a spoon. This rubbing should be continued—re-wetting the photograph if necessary—until all shiny spots or air bubbles are removed. When dry, rub away nearly all the paper with sandpaper, finishing off with pumice powder. The picture may next be rendered transparent by the use of 2 parts of Canada balsam to 1 part each of white wax and paraffin wax or, preferably, poppy oil. Or clearine, which is a preparation sold for this purpose, may be used. The colours, thinned with megilp and rendered opaque by mixing with white, are laid on the glasses. The delicate and sharp touches are placed directly on the film, and the deeper and bolder work is done on the second glass. A strip of paper should be pasted all round the edges of the front glass so that the two glasses may be kept from absolute contact. A piece of cardboard is then glued to the back of the picture, and the two glasses being placed together are bound round the edges with paper. The paper may also be removed by rubbing whilst damp, but this method is very risky. Considerable trouble may be saved and more even results obtained by using "Novitas" stripping P.O.P. The film strips readily on placing in warm water, and may be transferred to any article (previously coated with a strong solution of gum arabic) by lifting on a sheet of parchment and stroking out air bubbles as before mentioned. Eastman's transferrotype can also be used for the same purpose.

Strength of Concrete.—It has been found that the strength of concrete regularly diminishes as the proportion of cement becomes less. Approximately the results follow the formula $F = 150 - 10B$, where F = crushing force in tons per square foot, and B = quantity of ballast to 1 of cement. (See vol. iii., "Notes in Building Construction," pp. 208–9.) Sutcliffe's "Concrete" quotes three tests by Kirkaldy for strength of concrete beams as follows. (1) Beam of 1 Portland cement and 1 coke breeze, seven days old, 3 in. broad, 5 in. deep, 72 in. clear span. Breaking weight loaded in centre average 3·85 cwt., or allowing half-weight of beam between supports a gross central load of 4·07 cwt. (2) Beam of 1 Portland cement and 2 crushed bricks, two or three months old, 12 in. broad, 8 in. deep, 60 in. span. Breaking weight loaded in centre averaged 13·25 cwt., or a gross central load of 15·08 cwt. (3) Beam of 1 Portland cement to 6 gravel, ninety days old, 12 in. by 12 in. by 36 in. span. Average breaking weight on central 6 in. = 46·67 cwt. But it must be mentioned that the strength is subject to so many contingencies that experiments cannot be relied upon very closely. A reasonable practice is to let the thickness of concrete in inches equal the span in feet between main joists, and to put cross joists of about half-depth at half the distance apart.

Particulars of Wainscot Oak.—Oak boards and planks that show prominently a good silver-grain figure are spoken of as wainscot stuff. The term is not now, as was formerly the case, restricted to the oak brought from any particular country. Russian wainscot, Austrian wainscot, English wainscot, and American wainscot are the principal kinds now in the market. Russian wainscot oak is brought over in flitches, as shown in Fig. 1, Austrian stuff principally in plank form. English wainscot also is mostly in plank, and American rift-sawed or quarter-sawed oak, as it is called, in plank and in board. To obtain the figure it is necessary that the faces of the planks and boards coincide, as near as may be, with the direction of the medullary rays; the more nearly they do this, the higher the class of wainscot produced. Fig. 2 shows the ideal system of wainscot cutting, where each board in the log is made to fall exactly on the lines of the medullary rays. This method of cutting is expensive, and necessarily involves much waste of material. In America, where the production of good wainscot stuff is now receiving special attention, the modified system shown in Fig. 3 appears to be most popular. The figure in the outer boards of each group is obviously not so good as it is in the centre ones. When the divergence between the line of the ray and the face of the board is greater than 15° (see Fig. 3) the figure begins to be poor, and in most American ports such material would be graded as "Below Class III." It could hardly be described as wainscot.

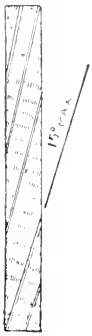


FIG. 4

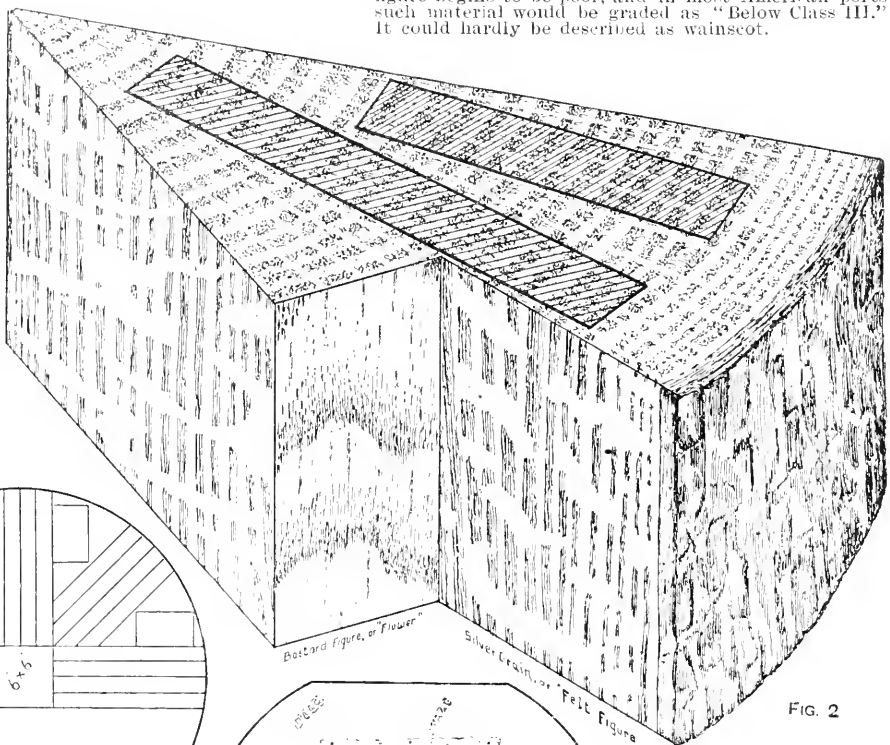


FIG. 2

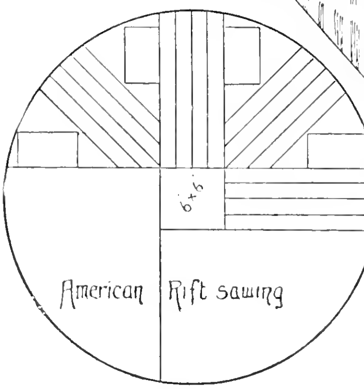


FIG. 3

FIG. 1

Wainscot Oak.

Cleaning White Buckskin Boots.—To clean a pair of sham buckskin cricket boots that have turned brown in places, first tree and then well wash them; let them get quite dry, then remove them from the trees and soften all parts, but more especially where the brown marks are, by well bending the leather backwards and forwards. Now put the boots on the trees again, give them a good hard brushing, and then well and evenly sponge into them some wet "Blanco." When nearly dry, well rub them all over with a piece of chamois leather; and when quite dry, well brush them, and finish by rubbing with a piece of dry chamois leather on which some chalk is placed.

Particulars of Watchmakers' Eye-glasses.—Watchmakers' eye-glasses are numbered according to their focal length in inches. A glass of short focus is stronger than one of long focus, and has to be used closer to the work. Thus with a 2-in. glass, the work is held 2 in. from the glass, and so on. A $3\frac{1}{2}$-in. or 4-in. glass is found the most convenient for ordinary work. If spectacles are not used, order a 4-in. glass.

Recipes for Rubber Stamp Inks. One method of making rubber stamp ink is to dissolve aniline in hot glycerine, straining while hot. A rubber-stamp ink that will not smear or blur burnished surfaces is made by dissolving 180 gr. of violet aniline crystals in 2 oz. of boiling distilled water. Add one teaspoonful of glycerine and half a teaspoonful of treacle. Dissolve about 1 dr. of aniline violet in 5 oz. of methylated spirit and 5 oz. of glycerine. Black aniline does not answer so well, and is usually mixed with a small quantity of violet or green aniline. Black ink for rubber stamps may be made by grinding vegetable black or lampblack in glycerine and then thinning with a little alcohol. Dissolve 3 parts of aniline colour in 10 parts of distilled water, 10 parts of acetic acid, 10 parts of alcohol, and 70 parts of glycerine. The ingredients above mentioned form the bulk of stamp inks, and though there are many recipes not given here, they merely differ as regards the proportions.

Roof of Corrugated Iron and Felt.—Roofing felt is usually laid on close boards, but as it is proposed to also lay corrugated iron sheets, the boarding can be dispensed with. In order to arrive at the proper distance apart of the battens, it is necessary to remember that roofing felt is usually 32 in. wide. It should be laid by commencing at the eaves at one end of the roof and laying a strip along the roof just above the eaves. The next strip higher up should overlap 3 in., and this brings the battens 2 ft. 5 in. apart from centre to centre, as shown in Fig. 1. The felt is nailed to the battens with galvanised-iron nails. If corrugated iron sheets 5 ft. long are used and of say No. 20 or No. 24 gauge, they will reach over two batten spaces and allow of 4 in. overlap at the ends. The sheets are usually fastened with round-headed galvanised screws screwed through ridges, not hollows, in the sheets, as shown in Fig. 2. By this arrangement the screw is kept clear of water flowing down the sheet. Corrugated-iron ridging can be procured or a wooden ridge covering can be made. For securing the sheets at the gables, the best plan is to make wooden barge-boards, as shown in Fig. 3, with a top table projecting 3 in. or 4 in. over the edge of the sheets. To carry the gutters without fixing brackets to the walls, some simple form of iron bracket can be nailed to the sides of the rafters or principals, as shown in Fig. 4.

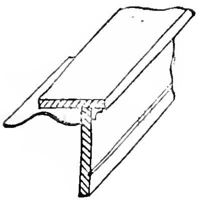


FIG. 3

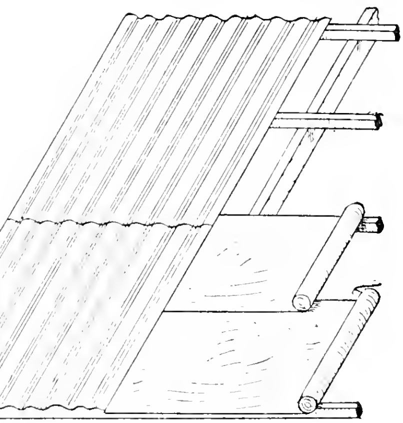


FIG. I

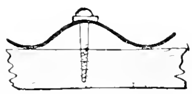


FIG. 2

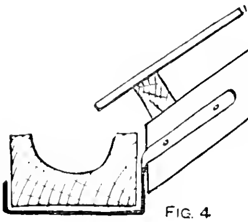


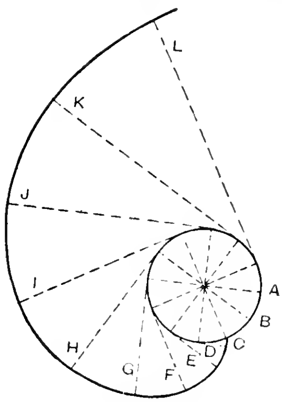
FIG. 4

Roof of Corrugated Iron and Felt.

Fixing Transfers on Cycles or Wood.—Transfers afford an easy method of decorating wood or iron; for wood they are generally printed in colours, often in imitation of inlays, though flowers, foliage, etc., may be shown if they give a pleasing finish. Gold decorations are chiefly used on iron bedsteads, japanned goods, and cycle and pianoforte makers' name labels. Generally speaking, transfers printed on stout paper are fixed with the minimum of trouble, but imitation gold transfers are mostly printed on thin tissue paper, which requires some practice to yield good results; therefore, those who desire a few transfers for trade or club purposes are advised to have real gold printed on stout paper. For cycles and japanned goods the use of a stove, though not necessary, is advised, as the clear varnish with which the design is finally coated will dry out harder than when finished cold. The transfers are printed on sheets and must be cut out, leaving a margin of white paper around the edge; if printed on stout paper, the transfer should be held up in a strong light and tally marks pencilled on the back as guides to ensure its being fixed true. Place the paper, face upwards, on a sheet of newspaper and cover it with an even coat of varnish. Then cut in around the design to form a thick edge. Work from right to left several times without recharging the brush, which should be of camel hair. Dip it in the varnish, and to work out the surplus press it over a piece of string stretched over the varnish jar, or work it over a smooth piece of wood. Any good quick-drying clear varnish will do. It should stand sufficiently long to have a good "tack"—that is, it should, when lightly touched with the knuckle, feel sticky without being wet. With gold or metal transfers, to be on the safe side, have them a trifle too dry; if wet, loss of burnish or brightness will result. The place on which the design is to be fixed having been wiped quite clean, place the varnished transfer in position and press the thumb down the centre, working outwards to remove air bubbles; for a cycle frame, press well down with the palm of the hand or with a soft cloth. Allow the transfer to stand a few minutes, then damp the paper with a sponge moistened with warm water. Press down again evenly, and apply water more liberally with the sponge. The paper should now readily lift if held by one corner, leaving every line of the design perfect. With thin paper the same procedure should be followed, the chief point to be observed being to avoid swimming the varnish on. In some cases better results are gained by applying the varnish where the design is to be fixed instead of varnishing the design. The paper being removed, the frame should be hung in the stove at a temperature of about 150° F. for ten minutes or so, the surplus moisture being first removed by a gentle dabbing with a clean moist washleather. Remove the frame from the stove, and whilst it is still slightly warm, apply a thin even coat of good clear varnish and stove again for twenty or thirty minutes or even longer; excess of heat will cause the gold to amalgamate with the asphaltum of the japan, and thus to turn brown. When there is no stove at hand, coat the design with a good spirit varnish or "transfer" varnish, which acquires the requisite tack in a few seconds. The design is then placed in position and pressed well home. Allow it to stand ten minutes and then damp with warm water; press home again and moisten more liberally; remove the paper and surplus moisture and set aside in warmth for at least an hour. Should the result have a scaly or whitish appearance only, wipe over with a trace of raw linseed oil; rub free from oil and apply a coat of varnish over the design. Several coats may be given, at intervals of half an hour. Better results may be gained if, instead of successive coats of spirit or transfer varnish, one only is given to fix the design and kill any trace of oil; then finish with a coat of best copal or coach varnish. Colour transfers are fixed in the same manner. In the case of wood decoration, the same general principle is employed, the design being fixed after the work is bodied up and the surface freed from grease, the subsequent coat of varnish used for protection being ofttimes discarded. White or transparent polish is applied by means of a pad and a lac surface built up that will give the appearance of inlay. Large designs require a rubber roller to press them well home. Transfers, when not required for immediate use, should be kept flat between the leaves of a book in a dry place.

How to Read and Regulate a Mercurial Barometer.—The following notes are on reading and regulating a mercurial barometer (Fitzroy pattern). The dial on the face is divided into set fair, fair, change, wet, very wet: these require no explaining. The numbers 29, 30, 31, etc., refer to the height of mercury in inches. One hand works round the dial as the mercury rises and falls; the other hand is stationary, but may be moved by a small knob below; this hand is set directly over the movable hand each day, and serves to show any change in the instrument. To regulate the barometer, it should be compared at a certain time, morning and evening of each day, with a standard barometer or with another barometer which is known to be accurate. If the readings are appreciably incorrect, open the back of the case and add or take away a drop of mercury as required; continue this treatment until the instrument reads the same as the standard.

Marking Out Involute Curves.—In marking out involute curves, first strike a circle as shown by the sketch; divide this into a number of equal parts, as A, B, C, etc., the more the better; from each of the points draw a tangent to the circle D E F G H I J K L. Now, supposing the curve to commence from C, make D equal to the distance from C to B measured on the circumference of the circle, E twice the length of D, F three times the length of D, G four times the length of D, and so on; from C, through the ends of D, E, F, G, etc., draw the curve freehand. This curve may be described mechanically as follows. Take a cylinder of wood, and on this wind a cord with a loop at the end; place a pencil point in the loop, and the cylinder with one end on a piece of paper; press the point on the paper and unwind the cord, keeping it tight, and the pencil will trace a curve similar to that shown on the sketch. Variations of the curve may be made by using an ellipse or any other form for the section of the solid from which the cord is unwound.

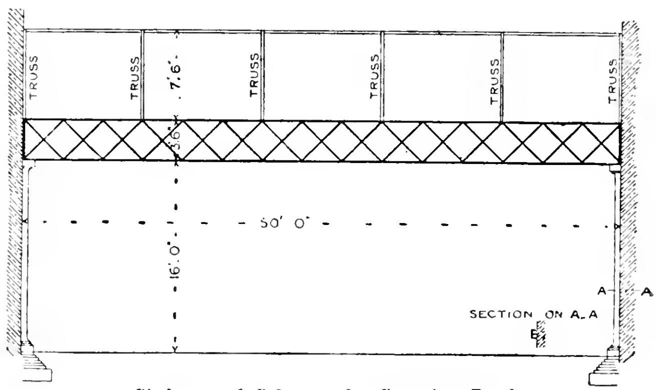


Marking Out Involute Curves.

How to Set Beetles.—To set a beetle, pin it through the right elytron (wing case) with an entomological pin, raising the body high enough to give sufficient space for the proper arrangement of the legs. The beetle is then pinned to a flat piece of cork, and the legs arranged, each joint of the legs being kept in position with common pins. Pins are also used to display the antennæ, and the specimen is then left for a few days to dry. When dry, the common pins are withdrawn, and the beetle is removed to the specimen drawer and pinned down on a card bearing its common and its scientific name. Beetles may also be set with gum. On a piece of card drop a little gum where the legs of the beetle are likely to come. Pin the beetle upon the card, and draw each leg into position and keep it there till the gum has set. Then put the specimen away to dry. The gum is afterwards dissolved, and the beetle set free, by soaking in water. Each foot is then gummed, and the insect is placed upon a clean card. It is advisable to kill the beetles as soon as caught, as some specimens are likely to be damaged by long captivity. If, however, they must be kept alive till home is reached, each specimen must be kept in a separate bottle, tube, or box. If kept together in one receptacle, they will not only damage each other in their efforts to escape, but the carnivorous kinds will devour the others.

Making Sympathetic Inks.—Writing done with sympathetic or secret inks is not perceived till the paper has undergone some preparation to render the characters visible. A great number of suitable preparations are known. The following is the composition of a sympathetic ink that becomes visible on being warmed. Form a very weak solution of equal parts of blue vitriol and sal-ammoniac in water. Another, nitrate of nickel and chloride of nickel in weak solution. Another, dissolve 25 gr. of chloride of cobalt in 1 oz. of water. Another, dissolve 1 part bromide of potassium and 1 part blue vitriol in 8 parts water and 1 part alcohol. Another, dilute sulphuric acid with water. Another, make a weak solution of cobalt in nitro-muriatic acid. Writing made with weak tincture of galls is invisible till wetted with a weak solution of sulphate of iron; *vice versâ*, a weak solution of sulphate of iron is not visible till moistened with a solution of galls. If a solution of alum be employed, the characters will be invisible till the paper be immersed in water. A solution of acetate of lead in water will not appear till moistened with a solution of sulphuret of potass, which renders it brown. To make a blue sympathetic ink, dissolve cobalt in nitric acid, and precipitate it by potash. Dissolve this precipitated oxide of cobalt in acetic acid, and add to the solution one-eighth of common salt; for the writing to appear, heat the paper. It is an awkward matter to write with a colourless fluid, so any of these inks may be mixed with powdered burnt cork. When dry, the blackness may be removed by the use of indiarubber.

Girders and Columns for Carrying Roof.—To carry a slate roof 30 ft. wide, with a clear headway of 16 ft. and with a span of 50 ft., there will be required four cast-iron E stanchions about 8 in. by 6 in. by ¾ in., with proper cap and base and good foundations. Two steel lattice girders in fifteen bays, with a depth of 3 ft. 6 in., and each capable of carrying with safety 20 tons distributed, and six king- or queen-post trusses if of wood, or of trussed rafter design if of iron, with the usual purlins, etc., will also be necessary.



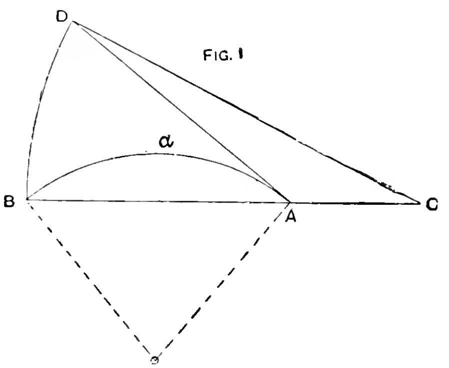
Girders and Columns for Carrying Roof.

Filling Engraved Ivory.—Engraved work that is to be subsequently filled is executed in the usual way, the cuts being kept as clean as possible. Then take a stick of the best black sealing-wax, break it into small pieces, and place in a 4-oz. bottle with stopper, if possible, pouring on sufficient pure spirit of wine to dissolve into a thick paste; then add more spirit to make it run, but not too freely—something like cream. To use, dip into the solution a steel tracer or point, and with the side of the point fill the cuts and leave to set all night. If a number of knife-handles are to be finished, rig up a small lathe carrying a linen polishing dolly, made by cutting out into circles, from 6 in. to 12 in. in diameter, fifty or more linen sheets, and screwing them tightly in the centre on a mandril. The speed of the lathe causes these to become erect, and the ivory handle is lightly applied as the dolly revolves, aided by a little whiting to grip the superfluous wax on the surface of the handle.

Ridding a House of Bugs.—When bugs are breeding in plaster, it is a very difficult matter to get rid of them. The bugs are easily killed, but the eggs remain and constantly produce a fresh supply. Treat the walls with good carbolic acid, washed on with a brush. It must be carefully applied, because it causes very serious burns if spilt on the hands; the walls should not be otherwise touched until the bugs disappear, and if they appear in patches, treat those portions thoroughly.

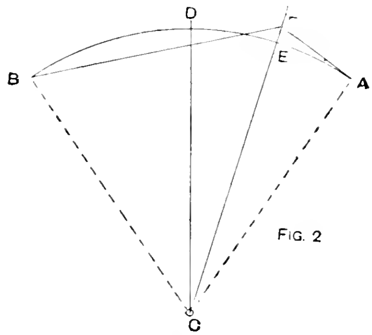
Falls for Drains.—The falls for drains are governed by circumstances, such as when laid in flat and when in hilly districts. When not sufficient the drains will silt up, and when too great the inverts are worn by the scour of the grit, etc., carried along with the sewage. In the latter case the falls have to be broken by steps. The minimum for drains should give a velocity of not less than 3 ft., and for sewers 2 ft. to 2½ ft. per second. The maximum fall should give a velocity of about 4½ ft. per second. For a 3-in. drain the fall to give this latter velocity is about $\frac{1}{30}$; for 4-in. drain, about $\frac{1}{40}$; for 6-in. drain, about $\frac{1}{60}$; for 9-in. drain, about $\frac{1}{90}$.

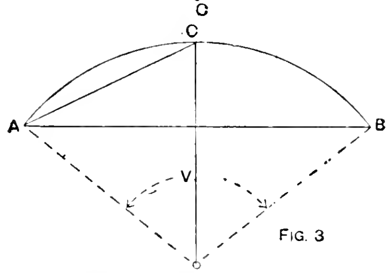
Developing Length of Arc.—The length of an arc cannot be developed accurately by geometrical means, but for all practical purposes the two following methods will be found adequate. In Fig. 1, let A *a* B be the arc whose length is required. Draw the chord B A and produce it to C, making A C half the length of B A. From C, with the radius C B, draw part of a circle, and from A draw the tangent A D, cutting this circle in the point D. Then the line A D will be approximately equal in length to A B, being a trifle short of the real length. If the arc subtends an angle of 60°, the error will be about one-thousandth part of the length. The second method is more accurate, giving results a trifle full. Let A B in Fig. 2 be the arc whose length is required, and C the centre of the circle of which it forms a part. Bisect the arc in D, and bisect D A in E. Draw C E and produce it. From A draw the tangent A F, cutting C E produced in the point F. Draw the straight line B F. Then a straight line of the length A F + F B



will be approximately equal in length to the arc A B. Apart from geometrical construction, the length of the arc may be measured by stepping a pair of dividers round the arc, counting the number of steps taken, and then setting out the same number of steps along a straight line. This will always give a result short of the actual length, but the smaller the opening of the dividers the more accurate will be the result. A more accurate way is to use a wheelmefna, or a special instrument called an opisometer. The length of the arc may be calculated as follows. Set out the arc either full size or to as large a scale as possible, as in Fig. 3. Measure the chord A B, bisect it, and set up a perpendicular cutting the arc in C. Measure A C, which is the chord of half the arc. The length of the arc is found by multiplying the length of A C, the chord of half the arc, by 8, from this product subtracting the length of the chord A B, and dividing the remainder by 3. If the radius of the curve is known, and also the number of degrees contained in the angle (V), the length of the arc may be calculated in another way, as follows. The circumference of the whole circle is found by multiplying twice the radius by 3·1416. Then, as the circumference contains 360°, the length of the arc will be proportionate to the number of degrees it contains, and can be arrived at by a simple rule of three sum, thus, 360° : degrees in the arc : : circumference : length of arc.

Preparing Iron Wire for Tinning.—One process of preparing iron wire for tinning is as follows. The wire, after it is taken from the annealing pan or oven, goes into the cleaning room, an outbuilding well ventilated so that dangerous fumes may escape. By the side of a wall in this room are troughs, either of earthenware or of wood, containing the chemicals. Secured in the wall just over the trough are two or three strong iron rods. The first trough contains grounds (old sour ale) and vitriol—say 5 qt. or 6 qt. of vitriol to 8 gal. or 10 gal. of grounds; it is made stronger by adding vitriol. The wire is left in this trough for from ten to fifteen minutes; it is then taken out with hooks made of ⅜-in. or ½-in. iron rod, and put into another trough containing clean water. It is here examined by the cleaner to see whether any scale, etc., is left on. If it is all right it is transferred to another clean-water trough, where it stays until all the vitriol is removed, the water then ceasing to bubble. The wire is then sometimes transferred to a trough containing a weak solution of bluestone and spirit of salts for a minute or two only, as if it stays in this solution too long it turns copper coloured; therefore this bath is better omitted. The colour can, however, be removed by dipping the wire in a solution of ammonia previous to tinning. The wire then goes to the tinning room (a little at a time, as if the wire is left in the open air it must be re-cleaned). It is dipped in a solution of muriate of tin. The rings of wire are then put on the winders of the tinning apparatus, and the wire passes first through a shallow trough containing killed spirit, then through the bath of "grain-bar" tin, and between two hard vulcanite blocks which remove excess of tin. Cleaners wear clogs and rubber-covered leggings, and, as vitriol is used, not extra good clothes; therefore, when taking the wire from the chemical solutions it is advisable to use the hooks and





Developing Length of Arc.

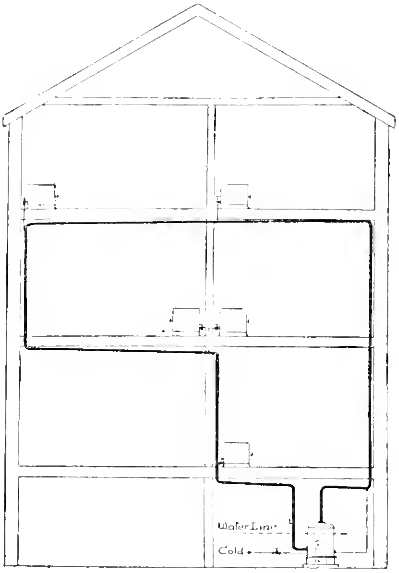
to hang it on the rods above the trough so that the liquid runs back into the trough.

Polishing Chisel Handles.—The better class chisel handles are finished in the lathe, the polish being applied with a pad of wadding that has previously been used on flat work, so that loose fluff may not be given off. After applying a small quantity of polish, the handle is oiled rather sparingly, and a handful of shavings left by the turner is held against it for the purpose of levelling and leaving a smooth surface for future operations; the use of glasspaper is thus avoided. The next rubber of polish is applied thinner, and repeated as often as necessary. Polish for turned work consists of ½ pt. of methylated spirit, 1 oz. of gum sandarach, 1 oz. of seed lac, 1 oz. of gum benzoin, and 1 oz. of best quality beeswax dissolved in sufficient turps to form a paste; add to the above after careful straining.

Renovating Veneered Furniture.—Unless the veneer is very badly damaged it would be better to replace the defective portions with new veneer; small places can be filled in with a mixture of equal parts of beeswax and resin; melt in an old iron spoon or ladle and add a little dry colour—Venetian red for mahogany, and umber for walnut. Press in with a slip of wood, level off with a knife or chisel, and finally smooth down with glasspaper. The old veneer may be removed by heating a flat-iron and pressing it well against the veneer; the latter can then be readily prized up by means of a stout knife or chisel. The old glue can be removed with hot water and rag; the rough surface which is left must be planed up and glasspapered in order to leave a surface fit for polishing.

Recipe for Boot Size for Kip Work.—To make a boot size that will give a brilliant polish as seen in factory made split kip uppers, boil some cheap glue, broken up very fine (or it may be dissolved in a glue pot), to prevent it burning; it should be quite thin, but not watery. Then boil some soap, and when both the glue and soap are well dissolved, add the latter to the former, well stir, put in a few drops of ammonia, and strain through muslin. If, when cold, the substance is thicker than cream, warm up again with more water. If it is old stock that is to be revived, logwood chips can be boiled with the soap.

System of Steam Heating.—The diagram shows radiators in five rooms of a three-storey house. This apparatus is on the one-pipe system. The boiler is in the basement. The main steam circulation can be 1¼ in., with single radiator branches of 1-in. pipe. The larger rooms (say 16 ft. by 14 ft. by 9 ft.) will require radiators with 22 ft. of surface each, and the smaller rooms (say 12 ft. by 10 ft. by 8 ft.) 12 ft. of surface each. Endeavour to get the rising main from the boiler up to its highest point as quickly as possible, and without any radiators on it. It will be seen that this pipe would have steam and condensed water travelling in it in opposite directions, and this is a frequent cause of noise. The thin pipe (½-in.) shown at the foot of the rising main is a drip to take the water



Steam Heating.

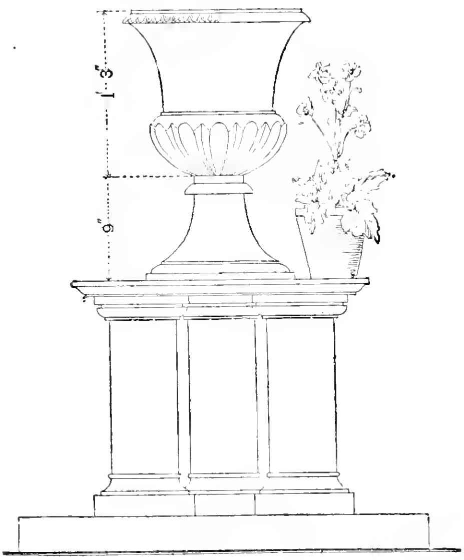
from this point to the boiler. All radiators are correctly shown as connected on to the falling pipe. The fall of the main from its highest point is 1 in. in 10 ft. Radiator branches rise from the main to the radiators. There is only one connection to each radiator, and this has a valve to control it. A trap or cistern is not needed, as the condensed water is returned to the boiler. A cold supply service is laid on to the boiler with a stopcock, and, as the water-line falls, water is allowed in to make good the loss. The loss, however, is very trifling, and sometimes the water may not need replenishing for days. A steam boiler with 150 ft. capacity will suffice, one that is a little larger, however, requiring less frequent attention. There should be an automatic draught regulator.

Dyeing Stockings Black.—For a fast black dye for stockings that have become green by exposure to the sun, dissolve 1 lb. of copperas and 2 oz. of blue vitriol in 1 gal. of water; place the stockings in this, raise gradually to the boil, and wring out. Then place them in a bath made by boiling 5 lb. of logwood chips in 1 gal. of water; raise to the boil, and keep boiling for about half an hour; pass through tepid water two or three times to remove the excess of logwood, and dry. Lay them out flat before they are quite dry, and hot press.

Making Collapsible Boat.—In the "Berthon" collapsible boat the stem, the stern-post, and the keel are permanently joined together. The fore and aft stringers are hinged at their ends to the stem and stern-post on each side, those uppermost being blocked out in order to allow the stringers to fold down to the keel. When opened for use, the stringers are kept in position by the thwarts and struts under them resting on the keel. The hinges are about 1½ in. apart up and down the posts, and are covered with leather, which is kept pliable by castor oil, neat'sfoot oil, or both. Shredded soap, dissolved and mixed with the paint, would keep the painted canvas pliable. For one person the size of boat would be: Length, 7 ft.; beam, 3 ft.; depth, less keel, about 20 in.; the width, when closed, about 8 in.; approximate weight, 30 lb. The wood used for these boats is Canadian elm; the canvas covering is double, the stringers and air space being between; on opening the boat the air enters this enclosure at the tholes.

Making Alcoholic Solution of Gelatine.—To make an alcoholic solution of gelatine to be used as a mountant for glazed prints, cover with water 1 oz. of gelatine, and allow to stand till quite soft; then melt down in a steam bath. While hot, add sufficient spirit of wine till the liquid just begins to appear cloudy; if too much is added, the gelatine will precipitate out.

Design for Garden Vase.—The accompanying sketch shows a garden vase of the most common pattern. It rests on a slab supported by three pillars, and the height of the whole might be about 5 ft. By making the slab as shown, sufficient space may be obtained on which to



Design for Garden Vase.

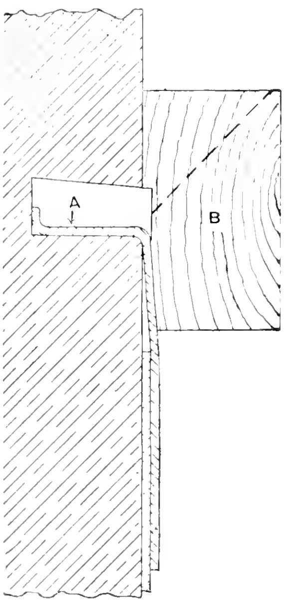
place a number of small flower-pots. The model of the vase is most conveniently made of plaster-of-Paris; the pedestal may be made either of plaster or wood. The moulds are of plaster, and from them the finished vase may be cast in cement. When making cement castings from plaster moulds, first varnish the inside of the mould to prevent the absorption of the oil by the plaster. It is possible to make the vase without a mould by constructing a framework of wood to form the inside of the vase, covering the framework with cement, and running a zinc template round it.

Loosening Slide of Cornet.—To loosen the slide of a cornet without damaging the instrument, pour a little paraffin oil on the slide and let it stand for a few hours; then wipe off, and gently warm.

Re-painting a Locomotive.—If the old paint is in a very bad condition, chip it off with a chipping hammer and scrape as level as possible; then give the engine two coats of lead colour (white-lead and patent driers in linseed oil coloured with black); stop the bad places with hard stopping, then fill up and rub down with pumice-stone and water, and give two more coats of lead colour. If the paint is in fairly good condition, clean off all grease with turps and a scraper and give two coats of lead colour. Stop the bad places with hard stopping and sandpaper down. Now give two coats of Brunswick green ground in oil and thinned with turps. Line and pick out with drop black ground in oil and thinned with turps. Varnish with best body varnish. Do not use terebine or boiled oil; the paint should be ground in linseed oil, and patent driers used.

Recipes for White Ink.—The following are recipes for white inks. White egg-shells are powdered in a mortar with clean water, and the powder is dried. Dissolve 1 part of white gum ammoniac in 3 parts of acetic acid; a gentle heat will aid this. Strain through muslin, and add 1 part of powdered egg-shell. To thin the ink, dilute with acetic acid. Write with a quill pen or sable brush. Pure whiting or Chinese white may be substituted for the egg-shell. Another and simpler recipe is to mix with a weak solution of arabic gum any one of the following. Flake white, French zinc white, white-lead, freshly precipitated barium sulphate, starch, or magnesium carbonate. The white substance must be reduced to an impalpable powder before mixing.

Lead Flashings "Burnt-in" to Stone.—The method of burning-in lead flashings abutting against stonework is illustrated by the accompanying figure. A groove, about ⅜ in. to ⅝ in. wide by 1 in. to 1¼ in. deep, is cut into the stone, the back of the groove being a little wider than the front. Into this the lead flashing is fixed as shown at A; a piece of dry deal, about 2 ft. long by 2½ in. wide by 1½ in. thick, made to the section as shown at B, is fixed over the groove and kept close by means of struts or weights. On the upper edge, three or four pouring holes and air-vent holes or notches are cut as shown by the dotted lines, into which molten lead is poured to fill up the groove. A greater length than 2 ft. cannot very well be done at one pouring, and to prevent the lead flowing out

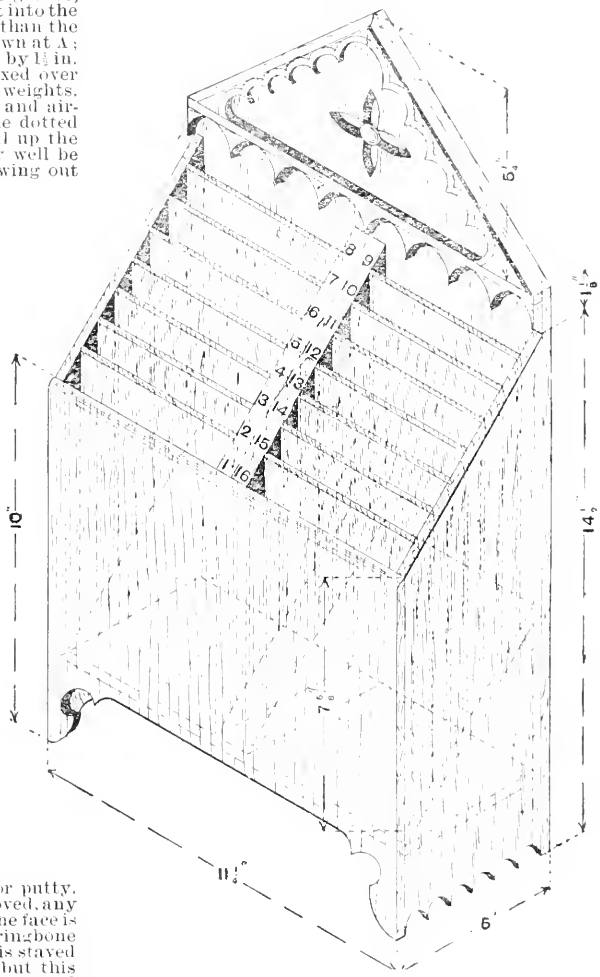


Lead Flashings "Burnt-in" to Stone.

at the ends they should be stopped with clay or putty. After pouring the lead, the piece of wood is removed, any feather-edges on the lead are trimmed off, and the face is hatched with a blunt hand-chisel to a herringbone pattern. Sometimes the face of the groove lead is staved to make it fit tight after shrinkage by cooling, but this is not a good plan, as the stonework is "stunned," and this results in a crumbling away after being wetted and exposed to frost. Flashings are not stepped in tooled stone walls, but are fixed in grooves cut parallel and raking with the roof.

How to Make Nickel Solution.—To make 1 gal. of nickel solution, dissolve 1 lb. of double sulphate of nickel and ammonia in as much hot rain-water as will completely dissolve the crystals. Let this get cold, then filter it through calico into the vat in which it is to be worked, and make up to 1 gal. with clean rain water. If best nickel salt is used, it will not be necessary to add either ammonia or table salt, these being employed to correct some fault in old and poor solutions. In working nickel solutions, they become too acid when insufficient anode surface has been provided. To correct this excess acidity, add liquor ammonia in small quantities until the solution ceases to redden blue litmus paper. When a solution ceases to deposit white nickel, a very small quantity of common salt is added, say ¼ oz. to the gallon of solution.

A Book Rack with Sixteen Divisions.—The book rack here illustrated will hold sixteen books. All the wood is ¾ in. thick, except the divisions, which are ¼ in., and the centre division carrying the numbers, which is 1 in. thick. In front should be a printed slip taken from the book list; it may be pasted on and can be renewed as alterations take place. The ornamental coping is planted on, and can be made to any design. The space allowed between the divisions, which is, of course, the space taken up by each book, is only ¾ in., but, if the collector has two books, the space is made 1¼ in. wide, with a corresponding increase in the size of the case. The ornamental coping may be 2 in. broad and



A Book Rack with Sixteen Divisions.

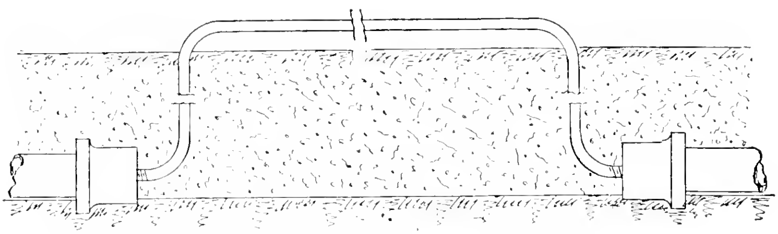
¾ in. thick, either rounded or bevelled. The divisions can either be fixed in by half-checking (in which case the sides should be ¾ in. thick), or, easier, by gluing strips between the divisions as the case is put together.

Cutting Plates for a Corrugated Roof.—Corrugated iron sheets are usually cut across the corrugation with a pair of bent-nosed snips; by using these, a good edge will be left after cutting, and the corrugation will be uninjured. Holes up to ¼ in. in diameter are punched with a small solid punch; those of larger diameter with a hollow punch, the punching being executed on a lead piece; the burr left from the punching is afterwards worked down smooth with a square-faced hammer used on any convenient tool. The principal point to be observed when riveting is to make sure the rivet is tight drawn through with a rivet set before hammering it over.

Composition for Repairing Ebonised Frame.—To make a suitable composition for repairing an ebonised picture-frame, crush a small quantity of gilder's whiting and mix it in a pipkin with sufficient dry lampblack to make a slate-coloured powder. Now pour a small quantity of very thin glue into the middle of the powder and mix the latter into a ball, well kneading with the hands. Place this putty in a wet state on the frame and build up all sharp edges to correspond with the original work. When dry and hard, sandpaper the repaired parts until level and smooth. Finish with a coat of black enamel which gives a good hard surface.

Sterilising and Peptonising Milk.—The best method of sterilisation is to place the milk in bottles provided with screw or plug stoppers, put the bottles in a steam steriliser, and gradually raise them to 100° C., keeping them at that temperature for at least half an hour; but by using an autoclave the temperature could be raised to 110° C., and about ten minutes at that temperature would be even more efficient. The milk would not have the burnt taste that it has when boiled over the fire, but it would not taste like new milk. It is very desirable to sterilise milk either before or after it has been peptonised, otherwise the bacteria present would grow at such a rate as to render the milk unfit to drink in a very short time. Sterilisation is only nearly perfect at a boiling heat, and for perfect sterilisation sometimes two or three boilings are essential.

Temporary Water Supply during Relaying of Main.—The simplest method of maintaining a water supply whilst a defective street main is being relaid is to cut off the ends of the defective main at the points between which renewal is necessary, to cap the ends of the pipes that are to remain, and fix ¾-in. or 2-in. (according to the number of houses to be supplied) wrought-iron pipe with screwed joints, for easy removal afterwards, as shown in the accompanying illustration. This will act as a by-pass, and supply all the branches that are not disturbed. Those that come in the defective part can be connected to the by-pass by means of tees. The temporary pipe can be laid on the surface and covered with earth out of the trench, to protect it from frost during the time the new portion is being laid. After the latter is done, the blank sockets can be burst off with hammer and hand chisel, and the connecting joints made between the old and new pipes.



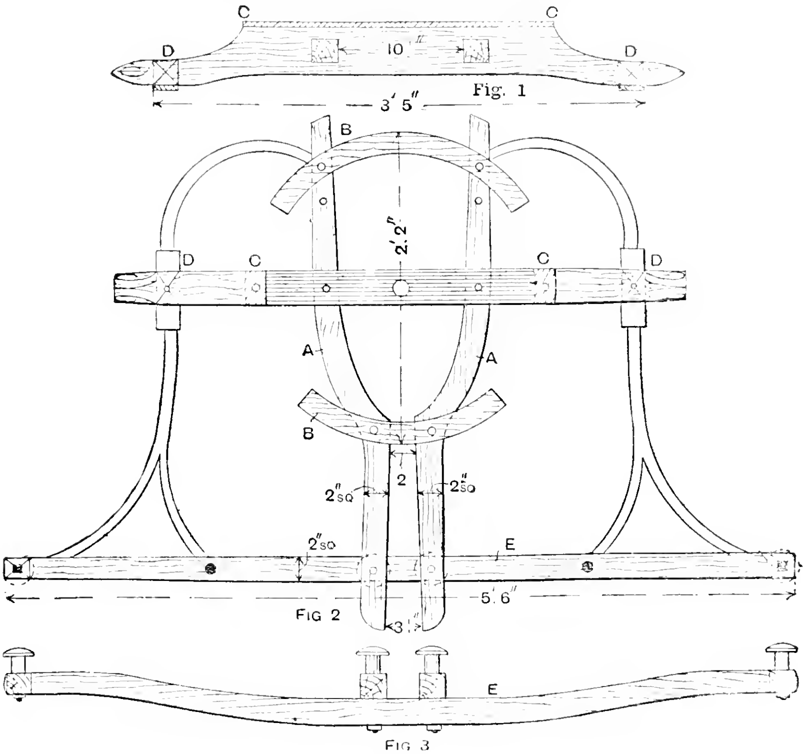
Temporary Water Supply During Relaying of Main.

Making and Applying Blackboard Dressings.—The characteristics of a good blackboard surface are intense black and absence of gloss; the former is desirable, inasmuch as the greater the contrast between the chalk marks and the colour of the board the more clearly will the characters show up. But that all gloss should be absent is more important still, as unless the lighting of the room is very favourable, a board having a glossy surface is sure to cause annoyance and trouble. A glossy board reflects the light, and, in consequence of this, it will be found that from some part of the room, at any rate, chalk marks on the board cannot be seen clearly. Therefore, the aim in blackening a board must be the production of a surface containing as little gloss as possible. There is no best way of blackening a board, as all dressings will, sooner or later, become polished by the constant friction of chalk and duster; and, in a general way, coatings that are less liable to this polishing action have another drawback. This is the difficulty of rubbing out the chalk marks that to some extent is possessed by all coatings in the composition of which an abrasive material, such as emery or pumice powder, enters, and which contain little or no binding agent in the form of shellac or gum. The following recipes and instructions are given as the result of much experimenting on the part of those who have afterwards published the results, and it is believed that below will be found almost every recipe of importance that has been made known during the last twenty years. The compositions given in recipes Nos. 1 to 7 are all applied over two, or preferably three, good coats of colour made with white lead, boiled oil, black pigment, and turpentine. Glasspaper each coat, which should be quite dry before the next is applied. Of course, the board should previously have been planed or glasspapered smooth. (1) Give a coat of flat drop black and japan gold size containing ½ lb. of flour emery to 1 pt. of black pigment. When dry, coat again; but add 1 part of turps to 3 parts of gold size used in the former coat. (2) Coat thinly but evenly with common black and driers and 2 parts of linseed oil to 1 part of turpentine. When dry, spread quickly a mixture of 3 parts (by measure) of best ivory black ground in turps and 1 part of japan gold size, and dilute with turpentine. (3) Give two coats of black mixed with boiled oil; smooth, when dry, with flour emery paper, then coat with black mixed merely with turpentine. (4) Coat with common dark lead colour or with common black paint, and then with a mixture of ivory drop black ground in turps, copal, or carriage oil varnish and turpentine. The greater the quantity of varnish used the greater will be the gloss; but some varnish is necessary to bind the colour. (5) Apply japan black and stipple a finish flat. (6) Give two coats of paint containing an excess of driers. Glasspaper the board after the first coat. (7) Give two coats of varnish colour, containing just enough varnish to produce an "egg-shell" gloss. When thoroughly hard, rub down with felt and pumice powder, and leave for a few hours before using. (8) The new board is well sized and then coated twice with oily, dark lead colour or common black paint. Before twenty-four hours have elapsed, apply a mixture of ivory drop black ground in turps, japan gold size or copal varnish, and enough turps to give a thin, watery consistency. This should produce a flat and lustreless black surface. (9) Grind lampblack in spirit varnish or alcohol, add sufficient flour emery to give a suitable surface, and thin with spirit varnish. Apply to the smooth board with a paint brush; allow to become thoroughly dry and hard, and rub down with pumice if too rough. (10) Dissolve in 4 pt. of alcohol (95 per cent.) 8 oz. shellac, and add lampblack 12 dr., ultramarine blue 20 dr., powdered rottenstone 4 oz., and powdered pumice-stone 6 oz. Shake the preparation and apply it with a new flat varnish brush as quickly as possible to the board, which must be free from grease. Keep the bottle well corked. Instead of alcohol, the shellac may be dissolved in a solution of borax in water, and coloured with lampblack. (11) Dilute silicate of soda (water glass) with an equal bulk of water, and add sufficient lampblack to colour it. Before being added, the lampblack should be ground with water and a little of the silicate. (12) Give the new board two coats of lampblack mixed with boiled oil and patent driers, and, when quite dry, coat with a mixture of burnt lampblack and turpentine. To prepare this mixture, place ¼ lb. lampblack on a flat piece of tin or iron on a fire till it becomes red; take it off and leave it until sufficiently cool, when it must be crushed with the blade of a knife on a flat board quite fine; then mix with ½ pt. of spirit of turpentine, and apply with a size brush. (13) One gallon of blackboard dressing may be made by rubbing into a thick paste 10 oz. of powdered pumice-stone, 6 oz. of powdered rottenstone (or infusorial silica), 12 oz. of lampblack, and sufficient methylated spirit. Mix this with the remainder of a gallon of spirit in which 14 oz. of shellac have been dissolved. Apply two coats, constantly stirring the paint. Apply the second coat lightly. This quantity of dressing is sufficient for 60 sq. yd. of board. (14) First coat with a mixture of shellac varnish and lampblack, and when dry, with three coats of a mixture of ½ gal. shellac varnish, 5 oz. lampblack, and 3 oz. powdered iron ore or emery; if too thick, thin with alcohol. Allow each coat to dry before putting on the next. (15) Give two or three coats of a solution of 10 parts of shellac in 90 parts of alcohol to which has been added 1 part of lampblack, 1½ parts of ultramarine, 5 parts of powdered Rochelle salt, and 7 parts of powdered pumice-stone. (16) Apply a dressing made by dissolving 20 parts of shellac in 200 parts of alcohol and adding

10 parts of ivory black, 6 parts of flour emery, and 5 parts of ultramarine. (17) Grind equal quantities of dry red lead and pumice powder in good varnish thinned with turps; add sufficient lampblack, and thin with turps. If desired, substitute wood naphtha for the alcohol and gold size for the varnish. (18) A good imitation slating is produced by applying pulverised slate or quartz rock, using silicate of soda (water glass) as the medium. (19) Give two or three coats of asphaltum dissolved in petroleum naphtha. (20) In many schools the walls are made to serve the purpose of blackboards. The walls are first coated with a size made by dissolving 1 lb. of glue in 1 gal. of water and adding a little lampblack. When dry, apply one of the above dressings. (21) Most of the compositions mentioned above are of the nature of paints, but stains are sometimes employed for the purpose, and meet with partial success. Three methods of staining boards are here given. Break 1 oz. of nutgalls into small pieces and steep for half an hour in $\frac{1}{2}$ pt. of vinegar contained in an open vessel. Add 1 oz. of steel filings, allow to stand untouched for two and a half hours, and then apply it with a brush. The second method is to brush in a solution of sulphate of iron, which should be allowed to soak into the wood, and then to sponge with a solution of nutgalls until sufficiently black. The third method is to apply a boiling solution of $\frac{1}{4}$ lb. of logwood in water; this should have stood for twenty-four hours and should then have been strained. When dry, give another coat, and when this is dry well rub the surface of the board with straw or something similar, and then apply one or two coats of a boiling solution of 4 oz. of copperas in 1 pt. of water. Chalk marks are not easily rubbed out on this at first, but the difficulty is lessened in a few days. The above instructions are on treating new boards, but recipes Nos. 9 to 20 are also suitable for renovating old surfaces. If for this purpose recipes Nos. 1-7 are also employed, proceed as if treating a new board which has already received its preparatory coats of oil paint. It may be mentioned that at many schools blackboards are successfully re-blackened by a weekly or bi-weekly application of ordinary black writing ink.

Removing Gold from Gilded Silver.—Gold may be removed from gilded silver by the following method. Mix together, in an earthenware, porcelain, or enamelled iron cup, 4 parts hydrochloric acid (spirit of salts), 1 part of nitric acid (aquafortis), and 1 part water. Make warm, and place the vessel on a hob in a fireplace with a good draught to carry off the fumes. Dip the silver articles one by one in the mixture until all the gold has been dissolved; then rinse well in clean water and rub in sawdust or bran until dry.

Under-carriage for 'Bus.—An under-carriage for a 'bus is illustrated by Figs. 1 to 3. Fig. 1 is a front elevation of the bed, as finished, and Fig. 2 is a plan of a pair-horse, close-futchell carriage (bottom part only). First draw this full-size, and from it make a pattern for the futchells A. The bed is first got out straight and square all ways; the futchells, of extra tough ash, are also square, tapering slightly at the back end. To frame them in, mark the centre of the bed on the top, and cramp the futchells on the bed at equal distances from the centre line; test with a wax line from the centre to see that one does not throw out more than the other. Then strike along the side with a marking awl, take away, and square the marks on to the back and front of the bed. The top of the futchell when let in should be about $\frac{7}{8}$ in. down from the top of the bed, and the mortise is cut a full $\frac{1}{16}$ in. lower behind than in front, to give the necessary pitch to the carriage. With the compasses strike off the felloe piece bearings B (Fig. 2), also the transom bearings C (Figs. 1 and 2); mark off the spring bearings D (Figs. 1 and 2), and the bearings for the splinter bar E (Figs. 2 and 3). This bar comes underneath the futchells, and is compassed as shown in Fig. 3. Knock apart, lighten the bed down as desired, and carve it and the futchells and splinter bar. Drive the futchells into place again, run the holes through for the felloe pieces, fit the ironwork, and finish off. As will be seen from Fig. 3, the two centre rollers bolts are put through the futchells first, and then through the splinter bar; usually the bolt end should be much longer than when received from the makers.



Under-carriage for 'Bus.

Cleaning Interior Stonework.—To clean interior stonework, wash it with dry soap and water, using a painter's ordinary brush. Now make a strong solution of American potash, thicken it with whiting to the consistency of cream, and paint it over the stone. After a few minutes wash off with a sponge or soft brush and cold water. If necessary, repeat. Do not let the mixture stay too long on soft or crumbling stone, or it may do injury.

Colouring Spirit Varnishes.—Spirit varnishes are coloured with coal-tar dyes soluble in spirit, and usually known as "spirit soluble" dyes. As a rule, very little dye is required. Perhaps the best way to apply it is to make a concentrated solution of the dye in spirit, and add this drop by drop to the varnish till it is sufficiently coloured. The names of some of the dyes are magenta, methyl violet, methylene blue, brilliant green, Bismarck brown, aurantia, eosin, nigrosin, etc.

Repairing Worn Stone Steps.—One way to repair worn stone steps when they are built in the wall is to cut the old tread away to a depth of 3 in., and then bed a 3-in. slab of hard York stone in sand and cement. If not built into the wall, and not too badly worn, the steps may be taken up, the treads reworked, and bedded and pointed in sand and cement, with a thin slab of stone bedded under as a riser to make up the original height.

Scantlings for Timber Roofs.—The accompanying table shows at a glance the respective scantlings for collar, king-post, and queen-post roofs. As to the various adaptabilities of these roofs, it may be stated that collar roofs are not adaptable for roofs above 18-ft. span, because the timbers would be abnormally large, the expenditure would be exorbitant, and the roof would be unsightly. King-post roofs are applicable for roofs of 18-ft. to 30-ft. span. Queen-post roofs are applicable for roofs 30-ft. to 45-ft. span.

Description of Roof.	*Span.*	*Tie Beam.*	*Principal Rafter.*	*King Post.*	*Queen Post.*	*Strut.*	*Straining Beam.*	*Purlin.*	*Straining Sill.*	*Common Rafter.*	*Collar.*	*Ridge.*
	Feet.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Collar Roof.	8									3 × 2	2 × 2	7 × 1¼
	10									3½ × 2	2½ × 2	7 × 1½
	12									3½ × 2¼	3½ × 2	7 × 1½
	14									4 × 2	4½ × 2	9 × 1½
	16									1 × 2	5 × 2	9 × 1½
	18									4 × 2¼	5½ × 2	9 × 1½
King-post Roof.	18	7 × 3	1½ × 3	4½ × 3		3½ × 2		7 × 3		3½ × 2		
	20	9 × 4	4 × 4	5 × 4		4 × 2		7 × 4		4 × 2		
	22	9 × 4	6 × 3	6 × 3½		4 × 2⅓		8 × 4		4½ × 2		
	24	9½ × 4	6 × 3½	6 × 4		4½ × 2¾		8 × 5		4½ × 2		
	26	9 × 5	6 × 4	6 × 4		4 × 3		8½ × 5		1½ × 2¼		
	28	10 × 5	6 × 4	6 × 6		4½ × 3		8¾ × 5¼		4½ × 2½		
	30	11 × 6	6 × 5	7 × 6		6 × 3		8 × 6		4½ × 2½		
Queen-post Roof.	30	9 × 4	5½ × 4		4½ × 4	4 × 3	7 × 4	8 × 4	4 × 4	4 × 2		
	32	10 × 4	6 × 4		5 × 4	4 × 3½	7½ × 4	8 × 4	4½ × 4	4 × 2		
	34	10 × 5	6½ × 4		6 × 4	4½ × 3½	8 × 4	8½ × 5	5 × 4	4¼ × 2		
	36	10 × 6	6½ × 5		7 × 4	5 × 3½	8 × 4½	8½ × 5	5 × 4	4½ × 2		
	38	10 × 6	6 × 6		7 × 5	5 × 4	8 × 5	8¾ × 5¼	5 × 4½	4½ × 2		
	40	11 × 6	7 × 6		7 × 6	6 × 4	8½ × 5	8 × 6	5 × 4½	4½ × 2		
	42	11½ × 6	7 × 6		8 × 4	6 × 5	8 × 6	9 × 5	6 × 4	4¾ × 2		
	45	12½ × 6	7¼ × 6		8 × 6	6 × 6	8 × 6	9 × 6	6 × 4	5 × 2		

Cements for China and Glass.—There are many cements for repairing china and porcelain. For large articles, plaster-of-Paris worked up with alum solution may be used; or plaster-of-Paris may be stirred into a clear solution of gum arabic. This should be used immediately, but is useless if the vessel to be mended has to hold water. A cement which is said to stand both heat and water is made by calcining and grinding oyster shells. These are then reduced to the finest powder possible with a muller, and the whole is beaten into a paste with white of egg. In using this preparation the broken parts should be pressed well together. A good cement for repairing broken glass is made by placing in a wide-mouthed bottle a small quantity of glue, just covering it with water, and allowing it to stand over-night; next day the excess of water is poured off and the glue is covered with methylated spirit. The bottle is then placed in a pan of water and heated until the glue is melted, then a little whiting is shaken into it, the bottle removed from the pan, cooled, and tightly corked. Sometimes a small piece of gum mastic, together with some ammoniacum, is added to such cements. Another useful cement for the purpose can be made as follows. Cover ½ oz. of gelatine with strong acetic acid, and, after standing, melt it down by placing the bottle in hot water. Both these cements are ready for use if they are placed for a few minutes in hot water. Another cement for glass, etc., is made by coagulating milk with acetic acid and washing the casein in water. It is then dissolved in a cold saturated solution of borax, and a clear solution obtained, which is mixed with finely powdered quicklime. This should be applied to the broken parts quickly, and the whole bound tightly with cord and gently heated. A sulphur paste for porcelain is made with sulphur, 7 parts; white pitch, 5 parts; bleached shellac, 1 part; glass meal, 7 parts; gum elemi, 2 parts; and mastic, 2 parts. A very strong solution for glass or porcelain may be obtained from casein dissolved in a soluble silicate of soda or potassium. To prepare pure casein, skim the milk of all cream and stand it in a warm place till it curdles. It should then be filtered, washed with water, tied in a cloth, and boiled in water. It should be allowed to dry on blotting-paper, and can then be kept for a long time. A waterproof cement for attaching glass to wood, slate, etc., is made by mixing together litharge, 3 parts (by measure); white lead, 3 parts; plaster-of-Paris, 3 parts; and powdered resin, 1 part. Make into a paste with boiled linseed oil, and use at once. For a transparent cement, boil isinglass in spirit of wine. A cement to repair porcelain or glass and to withstand heat is made by rubbing up in a mortar white of egg and a little dry lime. Paint this on the broken edges, put the article together, then paint strips of calico with the mixture and lay them over the broken parts outside, and allow to stand for several days. A coat of oil paint could then be put on, and would render the whole waterproof. Silicate of soda or potash (commonly known as water glass) sticks well to glass, and will stand heat. Either of these, however, attacks and slightly roughens the glass. Another heat-resisting cement for glass is the following. Pulverise together in a mortar ½ oz. of powdered glass and 1 oz. of fluorspar until they are reduced to an impalpable powder, then mix with 3 oz. of silicate of soda and work it into a smooth paste, which sets very rapidly. A reliable cement for repairing glass and china goods is a saturated solution of isinglass in pyroligneous acid. With the following cement, the article is required to dry slowly in a warm place; 10 parts of white lead and 6 parts of pipeclay, carefully dried, are incorporated with 5 parts of boiled linseed oil, heated on a water-bath. To repair a broken washhand basin, cover the outside of the parts to be joined with ordinary oil paint, then lay on a strip of calico, or thin canvas, and paint that outside. This is not very neat, but such a patch lasts for years. A solution of 8 oz. strong glue and ¾ oz. Venice turpentine, boiled and well stirred together, will unite glass and metal. To join glass to wood, make a cement by melting 1 oz. beeswax with 1 oz. resin, and stirring into it 1 oz. Venetian red. Use whilst hot, and warm the glass. If the wood is to join the edge of the glass, a groove in the wood will assist in holding it. Roughening the surface of the glass where the join is with emery powder will also help the cement to stick. In cementing white enamel or glass letters on windows, first dust French chalk over the glass, then coat the back of the letters to about ⅛ in. with white lead and japanners' gold size, which should have been mixed together twelve hours before. Press the letters well down, and clean the cement from the edges with a chisel knife. Another cement for the purpose, and one which dries quickly, may be made by mixing together 1 part white lead, 2 parts litharge, 3 parts boiled linseed oil, and 1 part copal varnish. The following cement has been recommended for uniting china to metal. Melt resin 20 parts, and stir in plaster-of-Paris 2 parts, and boiled linseed oil 1 part. If kept in a closed bottle, this cement may be used at any time by simply heating it.

Brush French Polish.—Brush polish is another name for spirit varnish. In a general way, 4 oz. of best shellac to 1 pt. of methylated spirit will answer for applying by means of polish rubbers. If the polish is to be applied with a camel-hair brush, it must be thicker—say 6 oz. to 1 pt. Some polishers mix equal parts of polish and best brown hard spirit varnish; if too thick, more polish or spirit is added; if too thin, add more varnish.

Making Cardboard Pulp.—To make a small quantity of fine cardboard pulp, cut a suitable piece of cardboard into small pieces, soak in water for an hour or two, and then beat it, in small quantities at a time, in a mortar until it is reduced to pulp.

Photographic Paper that does not require Toning.—Printing-out paper that would give a rich brown tone with simply washing and fixing and no toning can easily be prepared. The prints may be made on paper, linen, silk, wood, etc. Procure some pure Rives or Saxe paper (Whatman's smooth drawing paper is also suitable) and soak it for about ten minutes in a salting bath made as follows. Beat 180 gr. arrowroot into a cream with a little water, avoiding lumps. Boil 15 oz. water and pour in the cream slowly, stirring the while; boil for five minutes. Dissolve 120 gr. ammonium chloride, 200 gr. carbonate of soda, and 60 gr. citric acid in 5 oz. water, add to the arrowroot solution, and filter through muslin. The arrowroot or sizing serves to prevent the silver salts sinking into the paper, and gives brighter prints. Hang up the paper by the two top corners in a room free from dust. As soon as the paper is dry, cut it into sizes suitable for the sensitising dish, and put a pencil mark on the back of the paper in order to distinguish the sensitive side. So far the operations may be carried on in full daylight, but the remainder of the work must be done in an orange or yellow light, such as would be safe for handling P.O.P. The paper is next floated face downwards for three minutes on the surface of the sensitising bath, which is composed of silver nitrate 60 gr., citric acid 25 gr., water 1 oz. With practice it is quite possible to float large sheets of paper, but the beginner should use pieces not larger than 12 in. by 10 in. See that the solution well covers the dish; if not, level up with the wedges (A B C, Fig. 1). Take the paper by the two opposite corners and lower the near end X on to the surface of the solution, drawing into the near corner. Lower the part Y into position. Lift each side again slowly and, with a clean glass rod, break any air bubbles adhering. The paper may also be coated by pinning flat on a clean board and pouring a pool in the centre and spreading with a Blanchard brush made by binding some swansdown calico around a strip of celluloid, as in Fig. 2. This is convenient when short of solution, but unless carefully done an uneven coating is almost sure to result. The sensitised paper is pinned up to dry, which may take place quickly. Print in the usual way, but much deeper than for albumen paper. An image of a dull violet colour is given, which, when washed and fixed in a 10-per-cent. solution of hypo, becomes a rich red brown. The prints are then washed and finished as usual.

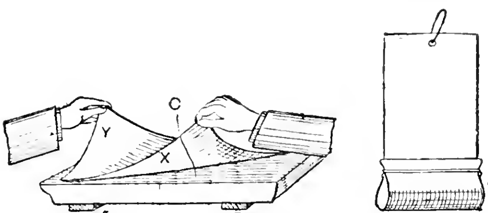


FIG. 1 FIG. 2

Preparing Photographic Paper that does not require Toning.

Deterioration of Silver-plating Solutions.—If a silver-plating bath is exposed to strong sunlight, a small portion of the free cyanide will absorb carbonic dioxide from the air and part with its cyanogen, and thus become converted into potassium carbonate. The loss of free cyanide may easily be made up by adding a small portion of potassium cyanide dissolved in distilled water. When silver-plating baths are not in use, they should be closely covered to prevent this loss, and to keep out dust. They should also be well stirred an hour or two before being used again.

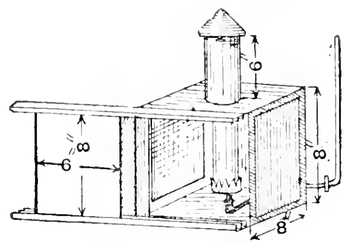
Cutting a Glass Bottle.—For cutting a glass bottle, a small jet made by drawing out a glass tube, or the mouthpiece end of a clay tobacco pipe should be connected to the gas supply by means of a rubber tube. Stand the bottle on a table and fill it with water to the height at which the bottle is to be cut, and make an ink mark around the bottle at the level of the water. Now empty the bottle, and with a triangular file make a deep cut on the lip of the bottle and, having lit the gas-jet, place it on the mark; after a few seconds remove the flame, and touch the part with a match stalk wetted; a crack will form at once, or after two or three trials. Now place the flame in front of the crack and lead it down the neck of the bottle to the ink mark, then right round the bottle.

Recipe for Black Harness Polish.—A good harness polish consists of beeswax 1 lb., soft soap 6 oz., ivory black ½ lb., and Prussian blue 1 oz., ground in linseed oil 2 oz., and oil of turpentine ½ pt. Mix well together and put in a pot. To use, lay a little on the leather and polish lightly with a soft brush or rubber.

Cleaning White Canvas Shoes.—In cleaning white canvas shoes having white leather facings, first tree the shoes, or fill them with soft paper. Well wash and scrub them, then give them one or two coats of "Blanco," made up in water to about the consistency of cream. Apply this with a sponge and, when nearly dry, brush out with a clean brush. When quite dry, take out the paper or trees and give the shoes a good hard brushing to remove all the "Blanco," except what is necessary to leave them a clean rough white.

Removing Old Paint from Iron.—One method of removing old paint from wrought-iron plates is to steep the latter for about twelve hours in a solution of common caustic soda (1 lb. to the gallon of water), and scrape off the softened paint with a knife as the plates are removed.

Photographic Dark-room Lamp.—Accompanying this is a sketch of a serviceable ruby lamp to burn either gas or oil. The lamp should have three illuminated sides, the front one to take ruby, orange, or opal glasses. The most convenient plan is to have these glasses fixed in frames so that they can be run in grooves on one side, as shown in the illustration; thus either one or all three can be used as required. With such an arrangement, it will not be necessary to regulate the lamp from the outside. The opal slide may be pushed in front when development starts, and may be run back when the image is fairly out. For slow plates, the orange slide is used alone; for isochromatic plates, the ruby slide; and for very rapid plates, the orange and ruby together.



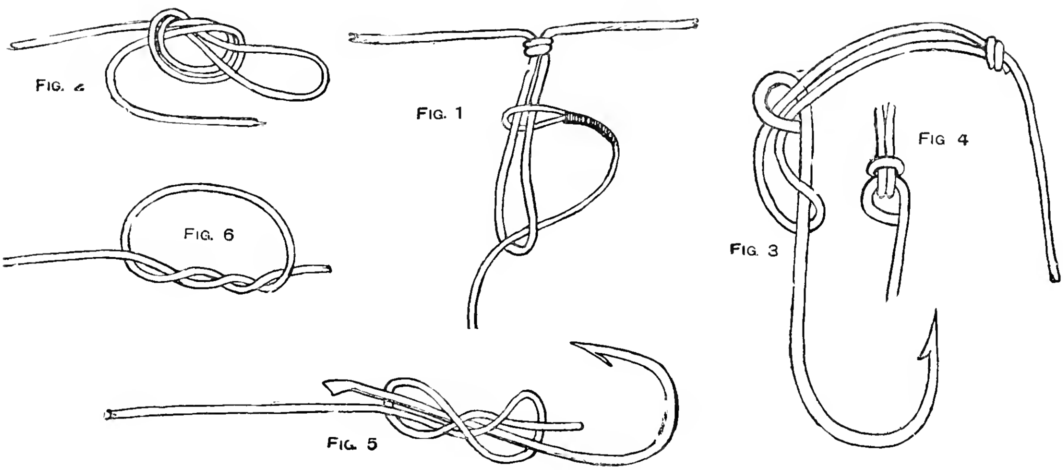
Photographic Dark-room Lamp.

Removing Red Ink Stains from White Marble.—To remove red ink stains from white marble, cover them with a little chloride of lime mixed with water, and wash off in about half an hour.

Brittle Gold.—The following are some of the causes of brittle gold. (*a*) Oxidation of copper and absorption of the copper oxide by the molten metal. (*b*) A pasty condition of the molten metal at the moment it is poured into the mould or ingot. (*c*) The mould may be too hot or too cold at the time of pouring the metal. (*d*) Absorption of some impurity from the flux. (*e*) Some impurity in the added copper or silver. The impurities in added metals may be arsenic, phosphorus, iron, or nickel in the copper; lead or zinc in the silver. Impurities in the flux may be grit and iron in the sal-ammoniac, and free mercury in the corrosive sublimate. In melting the metals for 18-carat gold, use a plumbago crucible lined with finely powdered charcoal and put the copper in first, then add the silver and gold. When the mixture is at the point of fusion, throw on its surface about two tablespoonfuls of finely powdered vegetable charcoal and finely powdered best sal-ammoniac intimately mixed. Use no other flux. When completely fused, stir the whole with the point of a red-hot iron rod, bring to the proper fluid condition for pouring, and hold a strip of wood to the mouth of the crucible to keep back loose flux whilst pouring the metal into the mould.

Staining Wooden Playing Bowls.—In re-staining bowling green bowls, any grease, dirt, oil, or varnish must be removed by re-turning in a lathe or by well scouring with strong soda water and pumice powder, or powdered Bath brick. When the bowls are quite clean and dry, proceed as with new bowls. Boil in an old iron pot for several hours 1 lb. of logwood chips, $\frac{1}{2}$ lb. of black or green copperas, $\frac{1}{2}$ lb. of extract of logwood, $\frac{1}{4}$ lb. of indigo blue, 2 oz. of lampblack, 1 oz. of nut galls, and 1 gal. of water. Strain through flannel, and apply hot; two or three coats may be necessary if the bowls are of hard wood, and the blackness may be intensified by brushing over, when dry, with another stain made by steeping plenty of rusty nails or iron turnings in common vinegar. A French black stain gives very good results.

Making up a Fishing Line.—The requisite materials for making up a fishing line are a good length of tanned water cord, some short lengths of pointed sticks, and some hooks. The latter will vary according to the kind of fishing; for eels or night lines, eyed hooks or those with the shank flattened are generally used, but for day fishing strong gut hooks are best. Cut the cord into lengths of 10 yd. or 12 yd., according to the width of the river, tie one end to a stick, and at the other end fasten a heavy lead sinker. About four hooks are sufficient, and the first one should be fastened about 18 in. from the weight and the others a little more than 1 ft. apart. To secure the gut hooks to the line, make a loop and tie a single knot (see Fig. 2), which, when tightened, will have the appearance of Fig. 1. Pass the loop of the gut over that of the line, and draw the hook through the loop on the line. To secure eyed hooks, form a loop in a piece of finer cord than that used for the line, about 8 in. long, tying it in a similar manner to Fig. 1. Pass the loop (Fig. 3) through the eye of the hook and over the point and draw it up to form a tie, as shown by Fig. 4. For day fishing the hook may be secured to the line as described for Fig. 1, but for night lines for eels use a swivel to prevent the line being twisted off. If hooks with flattened shanks are used, tie a double knot in a piece of cord similar to that used for the eyed hooks (Fig. 6). Pull the two ends and the knot will assume the form of a figure 8. Put the shank of the hook through both loops of the 8 (Fig. 5) and pull the knot tight, then cut off the ends. In using a line of this description, throw the weight as far as possible, then draw up the line tight, so that the hooks hang clear of the line.

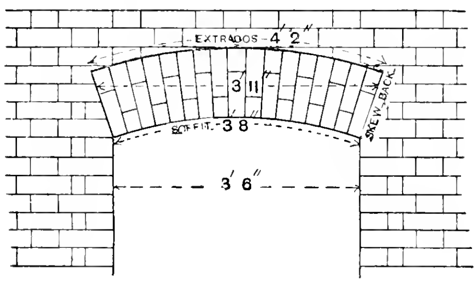


Making up a Fishing Line.

Recipes for Various Pastes.—The following information on making adhesive pastes for office and other use may be relied on. (1) Dissolve a teaspoonful of powdered alum in 1 qt. of water, and stir in enough flour to make a thick even cream. Then stir in a teaspoonful of powdered resin, and pour in a cupful of boiling water. After stirring, pour the whole into a convenient earthenware vessel, and add a few drops of oil of cloves. (2) Steep about $\frac{1}{4}$ lb. of small pieces of gelatine in about 1 lb. of water till they are soft. Then heat the whole to dissolve the gelatine, and pour into the mixture, while still hot, about 2 lb. of flour paste and 1 pt. of water. Heat this till it boils, and when it has thickened and is cooling, stir in a small quantity of silicate of soda and a few drops of oil of cloves. (3) Ordinary gum paste is made from equal quantities of picked gum arabic, white sugar, and water. The solution is evaporated till it is thick, and about three whites of eggs added per pound of gum. These should have been previously beaten up with a flavouring. The whole is strained through muslin, and evaporated until it will set. (4) Dissolve a heaped-up teaspoonful of powdered alum in a breakfast cup of cold water, and with this alum water mix the paste, crushing all lumps with a flat piece of wood. Boil slowly, stirring until the stick will stand alone. This paste does not become mildewed or offensive. Do not cover up too tight, and do not keep it in a tin, or put a tin-mounted brush in it, because of rust. (5) A quick-drying paste is made by mixing 100 parts of flour paste with 5 parts of dextrine or equal parts of glue and paste. (6) There are several materials from which an adhesive paste or gloy for securing labels could be made. By treating gum arabic with water; by treating dextrine (British gum) with water; by boiling glue for several hours with water, borax, and carbonate of soda, or by using fish glue. The first method is by far the best, yielding a stronger gum than any of the others. (7) Ordinary flour paste, made with the finest wheat flour and a small quantity of fine white sugar, keeps good for any length of time if a few drops of carbolic acid are added. (8) Four parts (by weight) of fine glue are softened in 15 parts of cold water, and then moderately heated until the solution becomes quite clear; 65 parts of boiling water are now added, with constant stirring. In another vessel 30 parts of starch paste are stirred with 20 parts of cold water, so that a thin, milky fluid is obtained without lumps. Into this the boiling glue solution is gradually stirred, and the whole boiled for a short time. After cooling, a few drops of carbolic acid are added as a preservative. This paste may be used for leather, and if preserved in corked bottles will keep good for years. (9) A paste possessing good keeping qualities is made by adding 15 grains of corrosive sublimate to 1 pt. of ordinary flour paste. Of course, corrosive sublimate is a deadly poison, and must be handled with the utmost care. (10) The gum used for envelopes, as also for postage stamps, is dextrine, which can be bought as a powder at the chemist's; for use, it is dissolved in water. (11) Billposters' paste may be made by beating $\frac{1}{2}$ quartern of wheat or rye flour with a little cold water. Pour slowly into this 1 gal. of boiling water, stirring the while until it thickens. The paste should be made in a galvanised pail, which should then be placed on the fire for a minute, the paste being continually stirred. For use, thin with cold water. A tablespoonful of powdered alum should be put in with the flour. For a billposters' paste that could be thinned down as required, mix powdered gum tragacanth with a little warm water to a paste, and dilute with cold water; 1 lb. of gum tragacanth will yield a strong gum with 10 gal. of water. To make a concentrated paste for billposters, mix common starch with a little water in a bowl, and then pour about five or six times its weight of boiling water on it while it is being vigorously stirred; this forms a stiff jelly, which may be readily thinned for use by admixture with warm water. (12) Paste as used by bookbinders is made

thus: Put a teaspoonful of best white starch into a cup, and make into a creamy paste with cold water; then pour boiling water over the starch, stirring quickly. When cold, squeeze through a piece of fine muslin. (13) To make shoemakers' paste, put some rye flour in a pot, pour on boiling water, and well stir. Do not pour on much, as the secret of making good paste is to make it as stiff and firm as possible. There must be no lumps, so, as there is such a little water added, the paste requires a lot of stirring, and even after it is cold and ready for use an occasional stir greatly improves it. Sometimes dextrine is added to shoemakers' paste. (13) This is a recipe for a cheap flour paste suitable for laying linoleum and oilcloth. Mix rye flour with a little cold water, then add boiling water, well stirring the paste while the water is being poured. Stir in some glue size while both are hot. The more size added the greater is the strength of the paste. A little alum dissolved in the paste is a preservative. If the paste is too thin, boil it to evaporate some of the water. (15) A waterproof paste for fastening tickets on ironwork and tin can be made by mixing a little rye meal with a solution of glue and water and a little Venice turpentine. If too thick, thin with Venice turpentine. Another paste for this purpose can be made by mixing 1 lb. flour with ½ lb. sugar. Boil carefully to thicken without burning. Add oil of cloves or other preservative. Another, 120 parts of gum arabic and 30 parts of tragacanth gum are separately steeped in water. A solution of 30 parts of tragacanth gum in water is stirred until it forms a viscous emulsion, and a solution of 120 parts of gum arabic in water is added and filtered in a fine cloth; 120 parts of glycerine are incorporated with the liquid, in which $2\frac{1}{10}$ parts of thyme oil have been dissolved. Finally, the liquid is increased to about 2 pt. by adding distilled water. Glue thus made is very adhesive, and to remain in condition should be kept in air-tight bottles.

Measuring and Charging for Gauged Arch.—Gauged arches are usually measured at per foot superficial as "extra on facings only on the cost of the general brickwork." Measure the whole surface of the face and soffit; for the face the mean length is taken midway between the soffit and the top of the arch. Measure the cutting to facings, and, if less than 6 in. wide, at per foot run. Give the name and quality of the bricks, and whether straight, segmental, or semicircular; whether set in cement or putty, and how pointed. The ordinary facings should not be deducted. Centerings also must be charged. The cost will vary according to the price of labour and material in each locality. The example illustrated shows the method of taking out quantities as described above:—



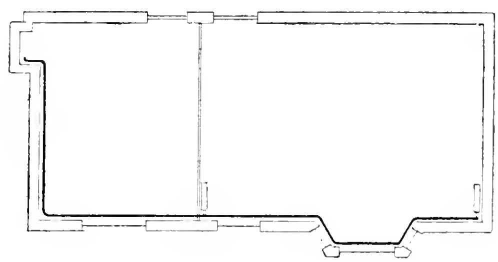
Measuring Gauged Arch.

ft. in.	ft. in.		
3 11 1 1	Super.		
	4 3	Gauged cambered arch, in best red rubbers, and set in putty.	
3 8 4½			
	1 4	Add soffit.	
	Run.		ft. in.
6 4	6 4	4½-in. circular and skew-back for fair cuttings to facings	Extrados 4 2 Skewback 1 1 do. 1 1 6 4

Laxton's Price Book gives the following. "Gauged arches not extra only, the brickwork and facings being deducted in the measurements. Of the best washed malm stocks, or red bricks, camber, segment, or semicircular, gauged, rubbed, and set in putty, at per foot super.: labour only, 1s. 7d.; labour and materials, 2s. 10d. With regard to rough-axed arches, measure the face and soffit, and describe as reduced brickwork; 'Extra only on facings.'" The best way, perhaps, is to number the arches, give length, allowing about 6 in. longer than opening, width of soffit, and depth, and describe as extra labour cutting and waste to rough arches. Laxton also says: "Extra only on facings. Red or malms, common segmental arch axed soffits, and all labours at per foot super.: labour only, 5d.; labour and materials, 9d. To find the value of extra only on facings, take the difference per thousand between the building bricks and the required facings, divide by ten, and the result gives the price in pence and fractional parts per foot super. Thus, stocks 40s., and facings 80s., difference, 40s. divided by ten, gives 4d. per foot; or, stocks 70s., and facings 85s., difference 15s., gives 1½d., and so on."

Distinguishing Hydraulic Lime Mortar.—So as to ascertain whether lime is hydraulic or not, after the mortar has been mixed, take a small quantity of the mortar, sufficient to make a ball about 2 in. in diameter, and also a pat (on a piece of glass or a plate) about 4 in. diameter and ½ in. thick. Let these remain until just set, then place carefully under water. If the lime is hydraulic, they will become harder and be quite firm by the next day, with the exception, possibly, of the outside skin; if not hydraulic, the sample pat and ball will be found to have fallen to pieces.

Heating Two Rooms from One Fireplace.—Below are some suggestions as to a suitable hot-water scheme of heating two rooms from one fireplace. The sketch shows a single line of pipe, which is all that can be shown on a plan drawing. There are, however, two pipes running in the direction shown, one at the ceiling level and the other along the floor skirting. Any ordinary grate can be fixed in the fireplace of the small room, but the fire-box should be of good size both in width and depth, as a large fire does better work than a small one and does it more economically. A suitable boiler should be placed at the back of the fire. From the top of the boiler carry a 1-in. flow-pipe, first up to within a few inches of the ceiling, then along as shown in the sketch to where the farthest radiator stands. Drop down to the radiator and then proceed along the skirting and connect up to the second radiator. The fireplace will heat the small room; while the large room, if there is no fire in it, will need two 25 ft. radiators in the coldest weather. The 1-in. circulating pipe must rise from the boiler at least 1 in. in 10 ft., and it must have an equal fall from the farthest radiator to the boiler. There must be a ¾-in. expansion pipe at the highest point of the circulation (over the farthest radiator) and a small cold-water feed cistern somewhere above the highest point of the circulation, with a ½-in. feed pipe coming down and joining the return pipe at any point, or it can enter the boiler low down. There must be an air cock on each radiator.



Heating Two Rooms from One Fireplace.

Paving Material for Stables and Cowhouses.—The floor of a cowhouse or stable should be formed of hard, impervious material, but should not be so smooth as to be slippery when either in a dry state or wet or coated with cowdung. Blue bricks or tiles having a surface formed of about 3-in. raised squares, and a groove ½ in. deep and nearly 1 in. wide, would be the best material for the purpose; this gives a good foothold when covered with cowdung or other similar matters. Granolithic concrete might be made to assume this surface by inserting ribs of wood when laying the concrete and taking them out when it is set. The hardness should be counteracted by covering the floor with a thin layer of straw, peat moss, or other bedding material. The inclination of the floor should be very slight, for physical reasons; 1 in. in the whole length from manger to gutter being ample.

Black Line Method of Copying Drawings.—The following process will produce black lines on a white ground from an ordinary drawing. Soak 150 gr. of gelatine in 5 oz. of water, then place the containing vessel in a saucepan of hot water until the gelatine is dissolved. Mix together 100 gr. each of ferrous sulphate, ferric chloride, and tartaric acid in 5 oz. of water. Add this to the warm solution of gelatine, and coat the paper quickly whilst the mixture is still hot by rubbing it over the surface. Choose any close-grained paper that is not too absorbent, pin this down flat, and apply the sensitising solution as evenly as possible with a sponge or a Buckle or Blanchard brush. The paper, when dry, is exposed to sunlight for ten minutes to half an hour, according to the density of the drawing on top of it, the two being kept in close contact in a frame or by laying both on a cloth-covered board with a heavy sheet of glass above. A faint yellowish image is printed, which is developed with oxalic acid 20 gr., gallic acid 100 gr., water 30 oz. It is an advantage to have a test negative at the side, with strips of the paper, which may be withdrawn as printing proceeds and developed as a guide to exposure. Under-exposure is shown by a sort of fog or veil over what should be the clear portions. When development is complete, pass the print through a bath of water rendered acid with oxalic acid or sulphuric acid; then thoroughly wash in running water. When placing to dry, press the print between blotting-paper. This process, sometimes known as the ink process, was introduced by Porterin about 1860.

How to Make an Opal Printing Frame.—A quarter-plate photographic printing frame in which the whole of the picture can be examined at once can be made thus: Substitute for the usual hinged back of a half-plate frame a piece of ⅜-in. board as shown in Fig. 1, sinking in it a recess A for the opal about ⅛ in. deep, or equal to the thickness of the opal to be used. The recess should be a little longer than the opal to allow room for the springs E and B, which clip the opal and hold it firmly. Two pegs are fixed at C and D to engage with holes in the frame and ensure accurate register. The back is held down by fold-over springs (see Fig. 2). By a method sometimes employed to prevent slipping, the back of the opal is touched with a composition of Canada balsam and wax.

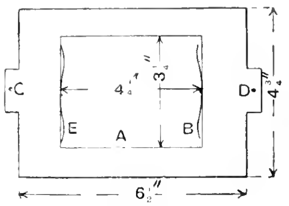


FIG. I

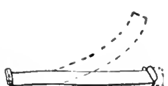


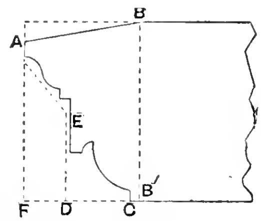
FIG. 2

How to make an Opal Printing Frame.

Cements for Celluloid, Xylonite, etc.—The following is a good cement for celluloid. Shellac 1 part, dissolved in 1 part of spirit of camphor and 3 to 4 parts of 90-per-cent. alcohol. This should be applied warm, the broken parts being held together securely till the solvent has evaporated. A cement for ebonite is merely a marine glue which can be made as follows. Dissolve pure india-rubber in naphtha by means of heat, then add 2 parts of shellac to 1 part of indiarubber; continue heating till the whole is melted. Whilst hot, pour the mixture on metal plates to cool. When using, remelt it, and apply hot, at the same time warming the articles to be joined. Squeeze the glue well out when making the joint. A cement that will stick xylonite or ebonite together may be made by dissolving pyroxylin (collodion cotton) in acetone or camphorated spirit to the thickness of cream. To make a cement for joining celluloid, etc., to gold or other metal, dissolve five or six pieces of gum mastic, each as big as a large pea, in as much alcohol as is required to make them liquid. Soften about ½ oz. of isinglass in water; wipe it dry when it becomes pliable, then dissolve it in strong brandy or rum, making enough strong glue to fill a 2-oz. bottle. A small piece of gum ammoniac or galbanum is next added, and stirred about till dissolved; pounding in a mortar would assist this. Heat is necessary to render the cement fluid. Another recipe is: Soak 1 oz. of isinglass till it absorbs 3 oz. of water, and add 4 oz. of spirit of wine (85-per-cent. alcohol). Dissolve as much gum mastic as 4 oz. of alcohol will take up, and add it to the isinglass solution. Powder 2 dr. of gum ammoniac, and mix it with the rest. The whole may be ground up with pestle and mortar if done quickly, so that the alcohol does not evaporate. Keep the cement in closely corked bottles, and heat it when about to use. To cement xylonite, etc., to glass, use either of the following. (1) Dissolve 2 parts of white shellac and 1 part of Venice turpentine in 7 parts of methylated spirit, and pour off the clear liquid. (2) Heat Canada balsam on a stove until it is hard, then dissolve 1 part in 3 or 4 parts of benzine. Apply to the xylonite and allow to dry on, then moisten with a little of the warm solvent employed in making, and press to the glass. Lip glue (that is, a mixture of glue size and sugar) might be used, but it would give way if exposed to damp.

Brazing Steel Articles.—A suitable solder for use in brazing small steel articles may be made in the proportions of silver 18, brass wire 2, copper 1. Melt in a crucible; when cold, hammer into a thin sheet, or granulate while molten by pouring into water. For small articles, a solder that will flow at a lower temperature than brass wire should be used. To braze or solder the article, clean the parts to be united and coat with pulverised borax which has been previously heated; cut off a narrow strip of the solder, if in the sheet, and place on the parts to be united, then heat until the solder fuses. The solder should be used sparingly.

Working a Circular Moulded Stone Cap.—When working a circular moulded stone cap, work the stone first to the parallel thickness required, and draw on centre lines at right angles to each other, their point of intersection being the centre of the circular cap. These lines should be "boned" through the beds so that they are in the same plane and coincide with each other, dividing also the circumference into four quadrants, to facilitate the working. This being done, scribe in on the top bed (with compasses or trammel) the nose line, which is the extreme size of the stone, as at A and the wall line B in the accompanying figure. On the bottom bed scribe in the wall line B′, the fillet line C, and any of the other members or fillets projected down. Now work the nosing all round, squaring in from the top bed, and gauge on the two parallel lines the width of the nose. Next take a chamfered check out roughly as shown on section at A, E, D, F, and clean in the fascia E; this may be squared in from the bottom bed, or a concave template may be used for guidance, squaring in only four of the points at the centre lines instead of the whole line. Rough the mouldings out, and clean them in, with the assistance of templates and reverses. Lastly, finish the cap by taking off the weathering from the top bed.

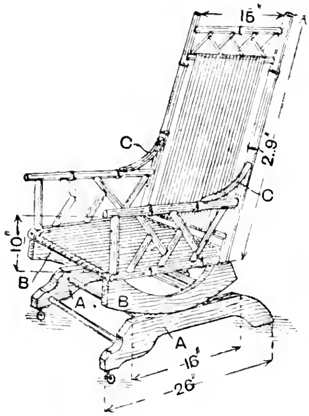


Working a Circular Moulded Stone Cap.

Stretching Paper on Drawing Board.—To stretch drawing paper on a board cut the paper ½ in. less than the board all round; then turn it over and sprinkle the back with water, spreading it over the whole sheet and leaving the ½-in. margin dry all round for the glue. Let the free water dry off and then turn over the paper, taking care to place it in position so that it need not be moved, as, the paper being moist, it drags heavily when being shifted. Place a full length straightedge on top of the paper, keeping it ½ in. inside the edge of the paper, put a heavy weight on each end of the straightedge to keep it from shifting, and then turn up the dry edge of the paper all along. Glue it down with thin hot glue and, after pressing the edge to the board, wipe off all superfluous glue with a clean cotton cloth wrung out in very hot water. This should be done carefully, as lumps of glue that harden on the edge will throw the tee-square out of truth. Do the same for all the other sides, stretching the paper as tightly as possible, and doing the longest sides first. The paper should be allowed to dry while the board is lying flat, as otherwise any free water underneath will drain down to the glue and prevent it setting properly. When the paper dries it will be found to be dead flat and stretched as tight as a drum. Drawing paper that is to be pinned down should be stretched and fixed from alternate corners, drawing as tight as possible.

Drilling Hard Steel Watch Pinions.—When drilling hard steel watch pinions, commence with a hard and sharp drill, and drill a little way only; then, before it ceases cutting, withdraw the drill and resharpen it, and so on until the hole is deep enough. On no account keep on drilling for a single revolution after the drill ceases to cut, but constantly re-sharpen. It is principally the backward and forward motion of a bow that causes the bottom of the hole to "glaze" when drilling tempered steel; consequently a watch lathe in which the motion is always in one direction is better. While a drill retains its cutting edge the work will not glaze. Having got the work glazed, the surface can be roughed by a piece of brass wire into which fine emery or oilstone dust and oil has been hammered at the tip end. Use the brass wire as a drill for a minute or so, then thoroughly clean out the hole and commence again with a sharp drill.

Bamboo Rocking Chair.—A working sketch of a base rocking chair with beech rockers and bamboo frame is here given. The rockers are made in two parts from $1\frac{1}{4}$-in. stuff. The two pieces A for the base can be joined together either with four birch or bamboo rails, 15 in. long when finished, and the front should have castors. The top rockers B are 17 in. long, and form the base on which the sides of the chair will be built; $1\frac{1}{4}$-in. or $1\frac{1}{2}$-in. canes should be used for this work. The two uprights should be fixed to the rocker with hardwood dowels, fitted into holes bored in the rocker at one end and into the hollow tube of the upright at the other end. These dowels must be a perfect fit, as upon them the



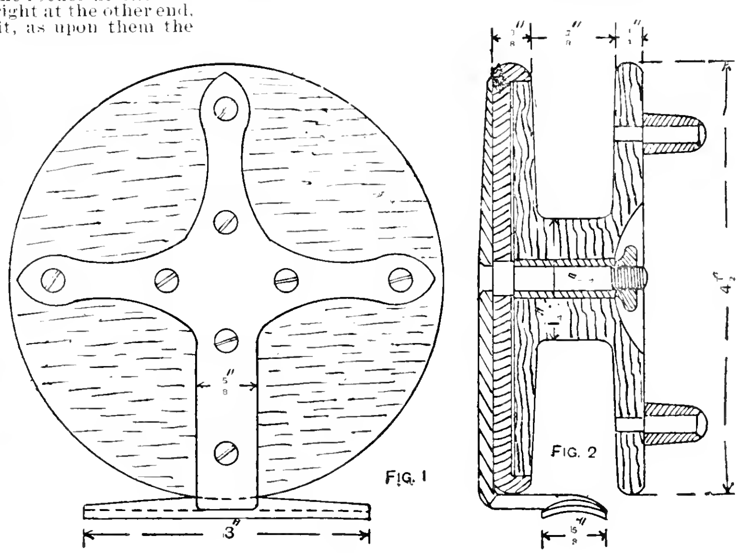
Bamboo Rocking Chair.

stability of the chair greatly depends. The two rails for the side and arm of the chair should be fitted, filled, and, after the uprights have been glued and fixed, screwed into position with round-headed screws. A piece of bamboo should be bent as at C, and fixed with nails as a stay between the arm and back of the chair. The herringbone work between the arm and bottom rail should now be fixed. The pieces for this work, after being fitted, should be filled with dowels so as to strengthen the arms. The two sections when set should be joined together with the six cross rails, which should be 15 in. long when finished. The rails to which the upholstering will be fastened should be filled right through with deal dowels to give a hold for the nails. The herringbone work should now be added to the back, and after the upholstering is done the chair will be ready for fixing to the base with two rocking chair springs.

Cleaning Watch Plates.—In cleaning watch plates, immerse them in benzine and brush them with a clean and soft watch brush and a very little dry chalk. The appearance when finished depends greatly on the original quality of the gilding and the age of the watch.

Removing Paint from Old Wood.—To remove paint from old wood, apply freshly slaked, hot limewash, to each bucketful of which from 2 lb. to 4 lb. of common washing soda has been added; use a common fibre—not bristle—brush. As the paint softens, scrape off with a painter's scraping or chisel-shaped putty knife. Repeat as often as necessary, using a thinner solution as the paint is removed. The above pickle will also darken the wood. Swill off with plenty of clean water, and when the surface of the wood is dry and perfectly clean, brush over with common malt vinegar, to kill any trace of lime or soda before applying varnish or staining medium. Woodwork that is required still darker in tone should be brushed over with one or more coats of bichromate of potash, 2 oz. to each pint of water. In order that the latter may be effective, the work must be perfectly free from oil, varnish, polish, or wax; otherwise a stained varnish will be necessary to bring all the work to an equal tone or colour.

How to Make a Fishing Reel.—Fig. 1 is a back view, and Fig. 2 a section, of a $1\frac{3}{4}$-in. reel for a fishing-rod. It would be cheaper to make the fittings, as to buy a single set would cost nearly as much as a reel. A pattern may be made of the back piece and handles, from which castings may be made. File the back piece, and drill the screw holes and the hole for the spindle. This should be made of a piece of $\frac{3}{8}$-in. steel rod, turned down to $\frac{3}{16}$ in. at the back and $\frac{1}{4}$ in. diameter where it passes through the reel, the outer end being fitted with a nut as shown. The spindle should be riveted and brazed into the back plate. A brass ferrule is bored out to fit on the spindle to form a bearing for the reel, through which it is driven tightly, a little shellac varnish being used to give greater security. For the woodwork, procure some thoroughly dry walnut, cocus, or ebony, and turn it to the sizes shown on the



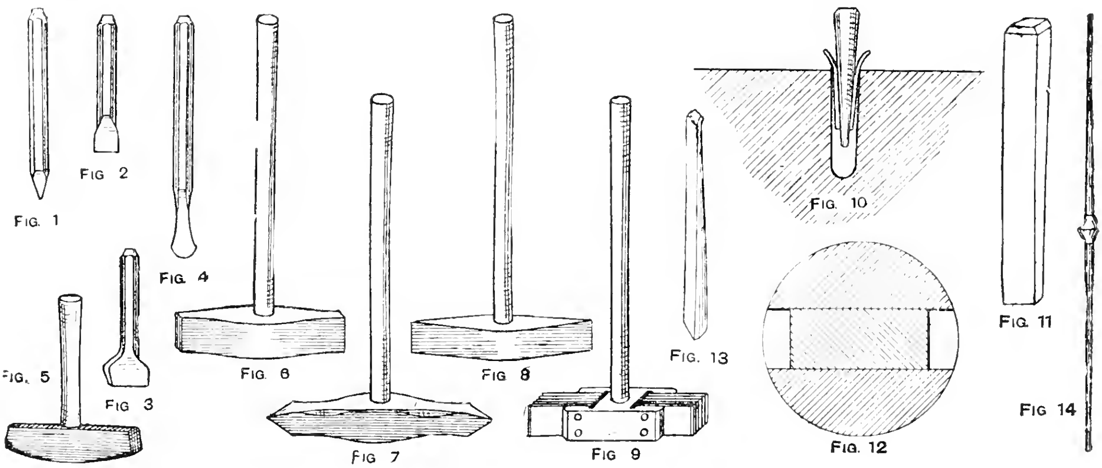
How to Make a Fishing Reel.

drawings, accuracy in fitting being essential. The handles may be of ivory or metal, and the spindles turned out of a piece of $\frac{3}{16}$-in. iron wire, or a couple of No. 10 wood screws may be adapted for the purpose.

Executing Designs on Sheet Copper.—Raised images, etc., are produced by stamping the copper. The art of engraving these steel dies is named "die-sinking." Raised designs in copper are also produced by punches or similar tools. This is named "repousse work." Raised images can also be produced on sheet copper by drawing the design with a varnish that will resist the action of acid, and then etching the exposed parts in a bath of dilute nitric acid. A similar result may be obtained by electrical action in a bath of dilute sulphuric acid, the plate to be etched being attached to the positive pole of a battery, and a plain sheet of copper to the negative pole. The process may be reversed, if desired, by carefully scraping the design on a varnished plate and depositing copper on the exposed parts in a bath for electrotyping.

Repairing Worn Stone Steps.—This is a simple method of repairing stone steps which are worn more or less right across the tread. Take a plan of the staircase, and have new treads sawn, $1\frac{3}{4}$ in. thick; also fix new risers, $1\frac{1}{2}$ in. thick, with proper cramps to the old tread, and allow the new tread to project $\frac{3}{8}$ in., so that the pointing can be neatly finished. The tread will be greatly improved by the additional $\frac{3}{8}$ in. The difference in the first riser is obviated by always keeping a stout mat in position.

Tools for Dressing Granite.—Fig. 1 represents the punch that is used with the hammer for removing superfluous waste and for pointing the face to almost any degree of fineness. Its cutting edge is sharpened to a stumpy pyramidical point. Fig. 2 shows a hammer-headed chisel used with the hammer for drafts, margins, mouldings, etc. The pitching tool shown at Fig. 3 has a bevelled instead of a cutting edge, and is used with the hammer for pitching and knocking off irregularities or waste lumps on block. Fig. 4 shows a jumper; the tool illustrated is sometimes known as a hand-drill. This is chisel-pointed and slightly round-nosed; it is wider at the cutting edge than the diameter of the tool, so that it clears itself in cutting or drilling circular holes, for which it is used. Fig. 5 shows a hand hammer (sometimes termed a mash or maul), which is made of steel and varies in weight, though 5 lb. is a good average. It is chiefly used with the punch for removing waste and also for chiselling, jumping, etc. The spaul or spall hammer shown in Fig. 6 varies in weight from 12 lb. to 16 lb. It has a square edge of about $1\frac{1}{4}$ in., and is a very effective tool for knocking off rough lumps. Fig. 7 shows a pick, about 14 lb. to 16 lb. in weight, which is chiefly used for dressing the inequalities of the rough or rock face, close to the finished surface, or for leaving it with a picked face, and also for scabbling blocks roughly to shape. At Fig. 8 an axe of about 12 lb. or 14 lb. weight is shown. It is chisel-pointed for removing the inequalities left by the pick and for dressing the stone similar to tooled work, showing the marks or indents in parallel lines. Fig. 9 shows a patent axe. The body of this is of iron, with a slot at each end, in which a number of thin plates of steel, chisel-sharpened and of equal length, are inserted and tightly bolted together. This tool produces the finest description of face next to polishing. Fig. 10 shows plug and feathers for coping or splitting granite. The plug is conical and of soft mild steel, and the feathers are thin pieces of iron, slightly hollowed and bent to fit the hole. Holes are jumped in the granite about 5 in. or 6 in. deep, the distances apart varying with the tenacity of the material, and the feathers are then inserted. The plugs are driven in and are afterwards tapped with a heavy hammer till all have got a hold; then harder blows are given in quick succession, and the fracture or split made. In the West of England and in the granite districts of America the plugs used in splitting granite are about 5 in. long, $\frac{1}{2}$ in. wide, and $\frac{3}{8}$ in. thick, and, instead of being conical, taper to about $\frac{3}{4}$ in. (see Fig. 11), while the steel feathers are about 4 in. long, semicircular in section (see Fig. 12), and tapered upwards to almost a point, as shown in Fig. 13. The feathers are made of mild steel, and are supplied in long lengths by the steel merchants, the rods being a semicircle of $\frac{1}{2}$ in. diameter. Steel has superseded iron on account of its durability and greater cheapness in the long run. As has been remarked, sometimes a hand drill is called a jumper, but a jumper proper is shown by Fig. 14; this is in use in all Cornish quarries on account of the speed with which holes for cleaving can be made with it. Thirty holes may be made in half an hour with this tool, though the average is twenty holes per hour. Three-and-a-half-inch to 4-in. holes are deep enough to cut even the big blocks of Cornish granite used for the docks. The holes are put at an average distance of 4 in. to $4\frac{1}{2}$ in. apart, though they can be spread a little if the stone is thin, say up to about 1 ft. 6 in. thick. The grain, too, makes a difference, as in cutting the tough way the holes want to be closer together than for cutting with the grain. The jumper is from 5 ft. 6 in. to 6 ft. long, and has two bits, one for pitching, say, about $\frac{3}{4}$ in., and the other (called the bottomer) for pitching about $\frac{1}{8}$ in. less. It is used with both hands.



Tools for Dressing Granite.

How to Make Indelible Inks.—Many attempts have been made to produce an ink which cannot be removed by chemical means, and the most satisfactory ink has been found to be a solution of Chinese (or so-called Indian) ink in acidulated or alkaline water. Hydrochloric acid is used for the acid solution, and caustic soda for the alkaline water. With steel pens only the alkaline may be used. Indian ink is a preparation of carbon in a very fine state of division, and is not affected by any chemical. Another indelible ink is made thus: Saturate boiling water with borax, and add as much brown lac gum as it will dissolve, and then add lampblack. This ink dries with a gloss. An indelible aniline ink may be made by rubbing 60 gr. of aniline black with 60 drops of strong hydrochloric acid and 1 oz. of alcohol. Dilute this blue liquid with 3 oz. of water in which $\frac{1}{4}$ oz. of gum has been dissolved. Or mix lampblack with a solution of 5 parts (by weight) of lac and 1 part of borax in sufficient water. Impure Indian ink (by analysis) contains much animal glue, therefore if a small quantity of bichromate of potash be added to it, after being exposed for one hour to sunlight it should prove indelible. Another, mix together 3 oz. of pulverised verdigris, 6 oz. of sal-ammoniac, 2 oz. of lampblack, and 35 oz. of water. Shake well before using. Hausmann's indelible ink is said to be made by mixing 1 part of Trinidad asphaltum with 4 parts oil of turpentine and sufficient colouring matter—plumbago for black and vermilion for red. This is said to be the recipe for Close's indestructible ink: Mix 25 gr. of powdered cobalt with 200 gr. of oil of lavender; for blue-black ink colour with 3 gr. of lampblack, and for a red ink with sufficient vermilion. To make Gaffard's indelible ink, mix together 1 part of lampblack, 12 parts of potash water glass of the consistency of syrup, 1 part of aqua ammonia, and 38 parts of distilled water. For indelible marking ink, take $\frac{1}{2}$ oz. of any pigment used in making ticket inks and 1 dr. of salts of steel; mix with linseed oil to the proper consistency. Use with pen or metal stamp (not rubber). Indelible ink for glass or metal is made by boiling under cover borax 1 oz., shellac 2 oz., and water 18 oz. (fluid). Colour with lampblack and levigated indigo, and in two hours drain off and bottle. In certain safety papers, which have been invented, the object has been to introduce into the paper a chemical which should yield a black compound in contact with the ink. By Bellande's patented process, calomel, or a salt of iron, copper, or lead is combined with the paper. Calomel is preferable. If combined with the pulp, 25 per cent. by weight of calomel is added; if fixed to the surface of the paper by gums or gelatines only 4 per cent. of calomel is necessary. The ink used is 1 part of prussiate of potash and 1 part of hyposulphite of soda in 25 parts of thin gum solution.

Making Hair Wash.—To make a hair wash to remove scurf, use tincture of cantharides, 1 dr.; rum or rectified spirit, 1½ pt.; carbonate of ammonia, 1 dr.; and carbonate of potash, 1 dr.; a small quantity of eau-de-cologne may be added if desired. Shake till dissolved. Rub well into the scalp until a lather is formed; then wash out with water. Liquor ammonia would make the lotion stronger. A little hair-oil or lime cream should be applied to the hair next day, as the lotion removes the natural oil. This wash does not dye the hair. A liquid soap for shampooing may be made in the following manner. Dissolve 4 oz. of castile soap (cut into shavings) in 5 pt. of methylated spirit, and add a few drops of essential oil of lemon or bergamot.

Setting Out Mitre Lines.—When setting out a mitre block for mouldings meeting at right angles as shown at A (Fig. 4), it is only necessary to draw a square on the top block as shown at A B C D (Fig. 1), and then the diagonal A C is the mitre line. When the mouldings meet at an obtuse or acute angle, as B or C (Fig. 4), the better plan is to set out the mitre on a piece of board, as at Fig. 2. Smooth up a board and shoot the edge, then gauge a line about ½ in. (say) away from the edge and set out the required angle, as shown at F H G; now bisect this angle as shown, then H K is the mitre line. A bevel should now be set to the mitre line, as shown, and then applied to the mitre block. Reference to Fig. 3 will make this quite clear.

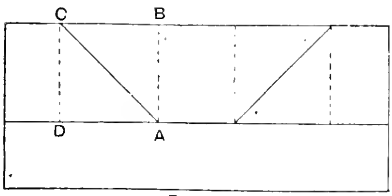


FIG 1

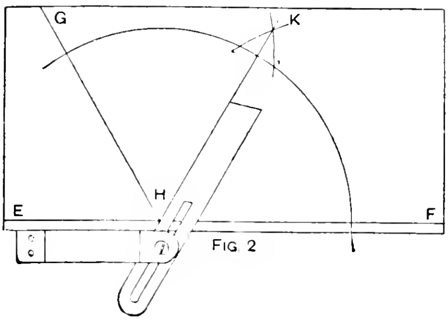


FIG 2

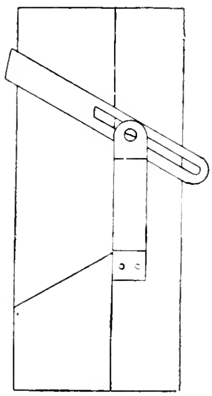


FIG 3

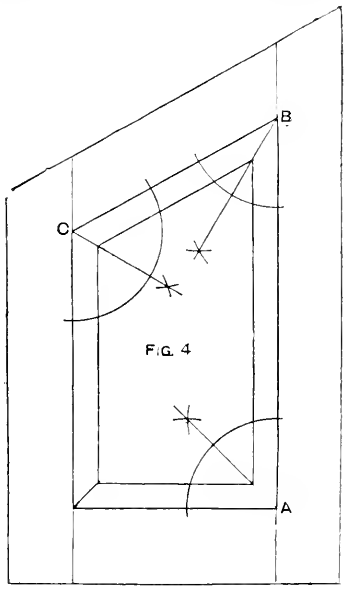


FIG. 4

Setting Out Mitre Lines.

Principles of Ventilation.—The following short summary of the principles of ventilation is taken from Messrs. Notter and Firth's "Practical Domestic Hygiene." The composition of pure dry air may be taken to be as follows. Nitrogen, 79·02 by volume, 76·84 by weight; oxygen, 20·94 b.v., 23·10 b.w.; carbon dioxide (carbonic acid), 0·04 b.v., 0·06 b.w. There are also present in the atmosphere, which is free from colour, taste, or smell, a certain quantity of watery vapour, with various impurities; and Lord Rayleigh and Prof. Ramsay have recently shown that about 1 per cent. of what was considered to be nitrogen is an elementary gas called argon. The nitrogen in the air is incombustible, and incapable of supporting life, and evidently acts as a diluent of the oxygen, which is necessary to life, combustion, and light. Carbon dioxide, or carbonic acid, is produced in all processes of combustion, and by the breathing of men and animals, as well as by the process of putrefaction. The watery vapour in the air prevents undue evaporation from the body and from plant life. The physical properties of the air are weight, expansion and contraction, and diffusion. The pressure of the air at sea-level is equal to 14·75 lb. per square inch of surface. The pressure on the atmosphere is never constant, but varies with the temperature and with the presence of moisture. The ventilation of ordinary dwellings is rendered necessary by the fact mentioned above—that when air is breathed or used up in combustion, its oxygen, which supports life, is exhausted, and is replaced by carbon dioxide, which, as already seen, is incapable of supporting life or light. Hence the necessity for ventilation, which is defined, in the book mentioned above, as "the dilution or removal, by a supply of pure air, of the products of respiration and combustion in ordinary dwellings." The average amount of carbonic acid given off by adults is 0·6 cub. ft. per hour, besides about 550 grains of watery vapour. A cubic foot of coal gas yields, on combustion, 0·52 cub. ft. of carbonic acid and 1·3 cub. ft. of watery vapour; while an ordinary gas burner may be reckoned as equal to at least three adults in its effect on the atmosphere. The atmosphere of the home, to be of the standard degree of purity, should not contain more than 0·6 part of carbon dioxide in 1,000, and in order to maintain this standard it is necessary to supply at least 3,000 cub. ft. of fresh air per head for healthy persons, whilst the sick need at least 1,500 cub. ft. of fresh air per hour. In actual practice, however, it is found that, in England, the air of a room cannot be changed more than three times an hour without giving rise to draught. Air at a temperature of 60 F., and moving at the rate of more than 3 ft. per second, becomes a perceptible draught; but if the temperature be, say, 70° F., the velocity of the air may be greater than 3 ft. per second without causing an unpleasant sensation of draught. Each adult in a room should have an air space of at least 1,000 cub. ft.; but in lodging-houses the allowance is only 300 cub. ft. In Board schools the regulation minimum allowance is 100 cub. ft. per head; in factories and workshops, 250 cub. ft. per head in the daytime, and 400 cub. ft. at night; for military barracks, 600 cub. ft. per head; while in hospitals the allowance ought to be quite 1,500 cub. ft., if not nearly 2,000 cub. ft., and the minimum floor space 100 sq. ft. The question of floor space is of considerable importance, and it is recommended that the lowest limit of floor space should be not less than one-twelfth of the cubic space. "It cannot be too well understood," say the authors of the above-mentioned excellent manual, "that cubic space is of no value when it is principally obtained by means of lofty ceilings. The space at the bottom of a well, if crowded, would speedily become unwholesome, although the air space above is unlimited; similarly, people have been known to die of suffocation in a crowd, though in the open air." A room, therefore, need not exceed 14 ft. in height, and 12 ft. is sufficient. Minimum floor areas prescribed are for soldiers in barracks, 50 sq. ft. each; for children in schools, 8 sq. ft. (but in newer schools the allowance is sometimes extended to 15 sq. ft.); patients in hospitals, 100 sq. ft. to 150 sq. ft. and more. From the foregoing facts it is deducible that proper ventilation is a means of renewing the air in an apartment without creating a draught; the inside air being constantly kept up to the standard of purity previously stated. An agreeable atmosphere for a room has a humidity of 60 per cent. and a temperature of 60° F.

Safety Valves of Range Boot-boilers.—The number of weights, which really means the weight of metal with which the valve is loaded, is controlled by the pressure of water in the boiler, and not by the size of the range. The customary method, when fixing dead-weight valves, is to have all the weights on when the boiler is first charged, and then to lift them off one at a time until water runs from the valve. Immediately water runs, put a weight on to stop the leak, and then put on one more weight—it is usual to put one weight more than is just necessary to prevent the valve leaking. This kind of valve should not be used on an apparatus having plug-cocks, that can be shut suddenly, as the sudden closing causes a shock in the pipes, and this may cause the valve to lift and eject water on each occasion that the tap is used quickly. A $\frac{3}{4}$-in. valve is the correct size for all kitchen boilers, and for small independent boilers. A boiler having more than 20 sq. ft. of effective heating surface ought to have one 1-in. valve or two $\frac{3}{4}$-in. valves. The six ring weights on a valve are not always sufficient if the house is a high one, with the cistern at the top and the range at the bottom; in this case lead rings or a solid lead weight are used. The pressure in feet should be stated when ordering these valves.

A Workman's Tea and Sugar Case.—Figs. 1 and 2 illustrate a convenient little case in which workmen can carry tea or coffee and sugar to work. It is made of scrap pieces of tin, such as come from an old corned beef tin. The side piece is tinned round, seamed, and soldered. The division piece, seen in Fig. 3, is next soldered in, and the bottom cut out and fixed. In cutting this, care should be taken to leave sufficient stuff to form the lap joint. The lid, Fig. 4, fits tight over a narrow rim soldered round the inside of the top edge. The division is placed beyond the centre to afford a larger space for the sugar than is required for the tea or coffee.

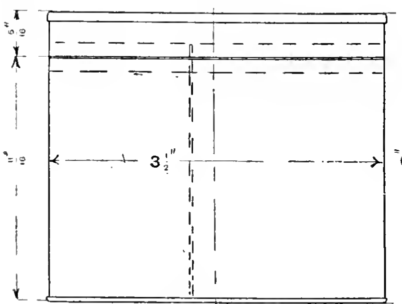


FIG. 1

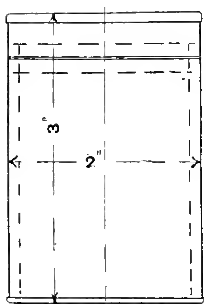
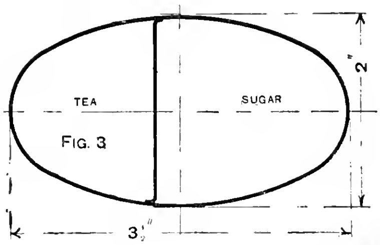
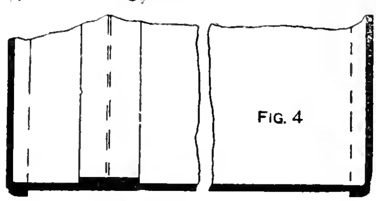


FIG. 2





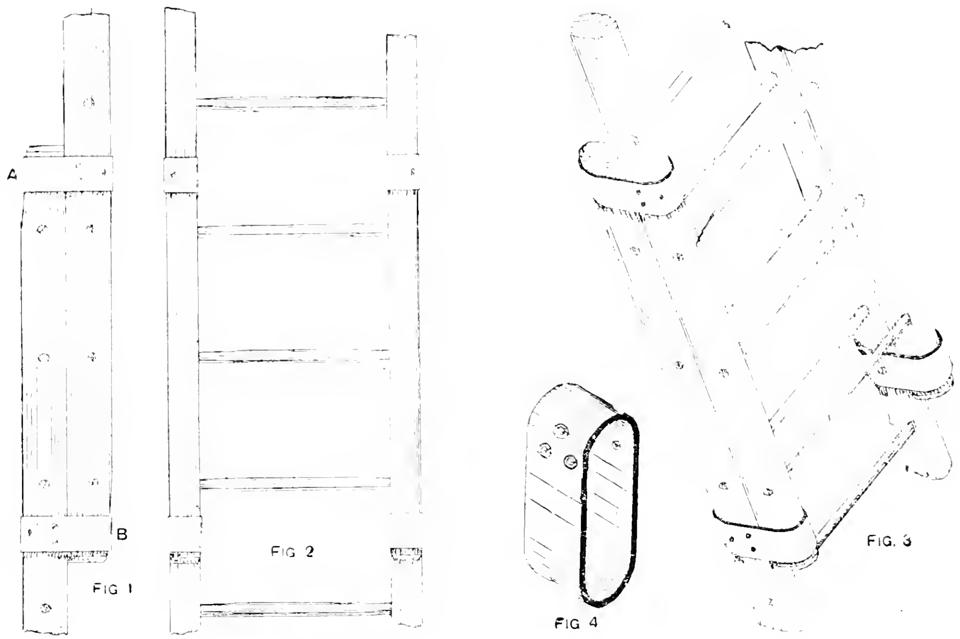
A Workman's Tea and Sugar Case.

Working in Real and Imitation Alabaster.—Alabaster is a soft, semi-translucent white sulphate or carbonate of lime; sometimes it has veins of yellow, red, or brown. A common material generally known as alabaster is made of gypsum (plaster-of-Paris) by a special process, and is hardened by subjection to a heat of about 300° or 350° F., for from 12 to 24 hours. When almost cold it is immersed in pure water or in a weak solution of alum for a few minutes. These operations have often to be repeated. Sometimes the imitation alabaster is suspended in an alum bath until the alum crystallises on the surface. The material is then polished with a wet cloth. The real alabaster is worked in much the same way as is marble. It is easily turned in the lathe, strong chisels of the kind used by carpenters being employed for the straight work, and point tools for roughing out. For turning hollows the chisels are ground round. The cutting angles require to be more obtuse than for cutting wood. Alabaster is also easily worked in the lathe with tools such as are used in ivory and brass turning. It is a common practice to construct alabaster ornaments in two or more pieces and then to cement these together. The following cements are recommended for the purpose. (1) Mix the curd, formed by adding $\frac{1}{8}$ pt. of vinegar to $\frac{1}{2}$ pt. skimmed milk, with the whites of five eggs. Well beat together and sift in sufficient powdered quicklime to form a paste. (2) Mix together by the aid of heat equal parts of plaster-of-Paris, yellow resin, and beeswax. (3) Sift powdered quicklime into thin rice paste. (4) Melt 2 parts of yellow resin and stir in 1 part of plaster-of-Paris. Apply hot to the warmed alabaster. (5) Plaster-of-Paris mixed merely with water is a simple cement. Powdered sulphur may be added to this. A means of decorating imitation alabaster is by etching. This process is executed by covering the surface, excepting those portions to be etched, with a solution of 1 part wax in 4 of turpentine thickened with a little finely powdered white-lead. The alabaster is then immersed in water for from 20 to 50 hours, according to the effect desired. The wax is then washed off with turpentine and the etched parts brushed with plaster-of-Paris. The real alabaster is etched in a similar manner, very dilute acetic or hydrochloric acid taking the place of the water. Another means of decorating alabaster is to colour it, but this is adopted as a rule only with the imitation material. Pigments that are not decomposed by contact with sulphate or carbonate of lime are added to the gypsum whilst in the wet state. Busts, medallions, etc., are coloured with sienna in powder or ground in water. For architectural purposes, the colour is added to clear size with which the plaster is worked up into the imitation material. Real alabaster may be coloured by applying hot liquid dyes or stains; the material itself should be sufficiently hot to cause the liquid to simmer. For blue stain use tincture of litmus or an alkaline solution of indigo; for brown, use logwood extract; for crimson, use alkanet root dissolved in oil of turpentine; for gold, use a mixture of equal parts of white vitriol, sal-ammoniac, and verdigris; for green, use an alkaline solution of sap green; for red, use tincture of dragon's blood, alkanet root, or cochineal; and for yellow, a tincture of saffron. The rough alabaster is polished in the following manner. It is first rubbed with pumice powder or dried shave-grass (equisetum) and water, and afterwards with a paste of powdered and sifted slacked lime and water. The final lustre is given by friction with finely powdered talc or French chalk. Another method of polishing is first to smooth the surface with rifflers, scrapers, or glasspaper, and then to remove all tool marks with fine sandstone or gritstone, such as robinhood stone, water-of-Ayr stone, or snake stone. Then rub with pumice, either in lump or powder, and water, following with putty powder and water. Soap and water finish the polishing, or, instead of this, calcined tin may be applied with a linen muller in the form of a cushion. Methods of cleaning alabaster and its imitation are the following. (1) Immerse in milk of lime (slaked lime in water) for some time, wash in water, and when dry dust with a little French chalk. (2) Apply benzol or pure oil of turpentine. (3) Wash with soap and water containing a little ammonia or soda. (4) Rub with soap and wash in hot water. If stained, apply fuller's earth, pipeclay, whiting, or quicklime for three or four hours and then wash off. (5) If very dirty, wash with dilute aquafortis or dilute muriatic acid. (6) Mix pumice powder with verjuice and allow to stand untouched for two hours. Then rub it into the alabaster with a sponge, and wash with fresh water applied with a linen cloth, afterwards drying with clean linen rags.

Making Hydraulic Cements.—Hydraulic cements, such as Portland cement, are made either by grinding and burning natural cement stones—that is, stone containing carbonate of lime or chalk and silicate of alumina or clay—or by grinding together in the wet state clay or mud and chalk, drying, and burning. The materials must be exceedingly fine; that is why Thames and Medway muds are preferred to clay. Paving stones as a rule are composed principally of silica, and are too hard to be ground fine enough. The material might, however, be mixed with Portland cement and moulded into artificial stone blocks.

Colouring Venetian Blinds.—Pine laths are generally finished with size and varnish, the latter alone imparting a sufficient hue. For a more pronounced tone, yellow ochre or lemon chrome may be mixed with the size; for walnut, add vandyke brown; for mahogany, add burnt sienna. For laths that have been already painted the use of self colours is advised, such as green, blue, or yellow enamels, though, as a rule, special preparations are used, with turpentine or resin varnish as the basis. The varnish green with which venetian blind laths are coated is made of ground mineral green, 2 lb.; white lead, 5 lb.; with turps enough to mix. Then add 7 lb. of turpentine varnish. Mix the other ingredients before adding the varnish.

Making an Extension Ladder.—The extension ladder illustrated in Figs. 1 to 3 will be found useful for light work. Three to four 8-ft. to 12-ft. lengths of straight-grained red deal, about 3 in. by 2 in., can be jointed together, the wood being free from knots and oval in section. Oak or ash is suitable for the rounds, old wheel spokes often being used for this purpose. The iron (Fig. 4) should be about ¼ in. thick and 2¼ in. wide. These irons should be welded, and prepared with screw holes as shown. They are fixed with screws on the sides about three rounds from the top before the sides and rounds are fixed together. So that the ends of the lengths shall fit tightly into the irons, and at the same time be easy to release, they should be tapered a little, as shown at A and B (Fig. 1). To allow for this, the long dimension of the iron should be about ½ in. less than that of the two sides.



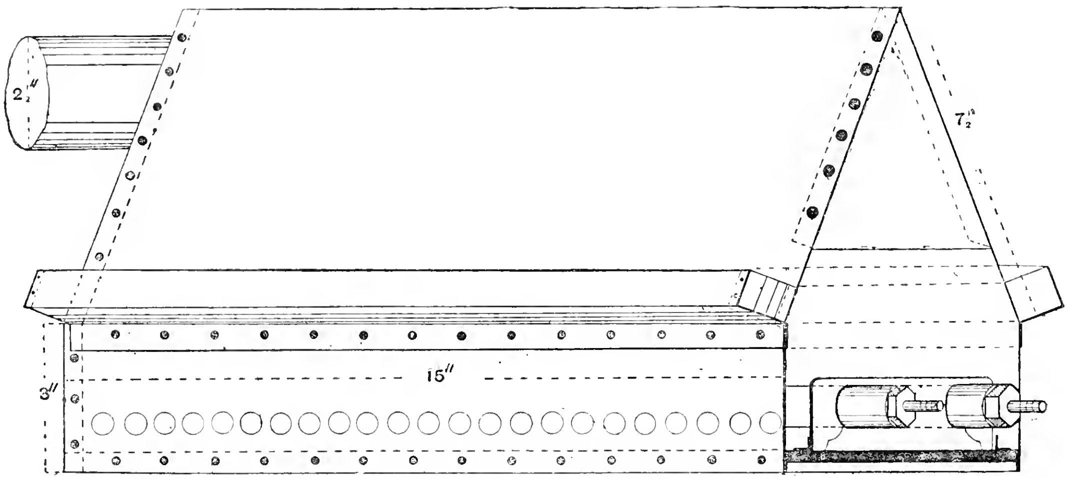
Making an Extension Ladder.

Recipes for Waterproof Cements.—Below are some reliable recipes for waterproof cements. (1) Rub magnesia with a little concentrated solution of magnesium chloride; apply this cement at once. It is soluble in acids, but not appreciably so in water. (2) Dissolve by the aid of heat 1 oz. of gum sandarach and 1 oz. of gum mastic in 1 pt. of alcohol, and add 1 pt. of turpentine and 1 qt. of strong vellum glue at boiling point. (3) Canada balsam is a good transparent cement. (4) Melt 4 parts of glue with a small quantity of water and 1 part of Venice turpentine. (5) Soak 6 parts of glue in water, and, when soft, pour off the excess; the softened material is melted by heat, and 1 part of bichromate of potash, dissolved in the least quantity of water, is added. This cement should be kept in the dark till required, then melted down by heat and applied. On exposing the cemented parts to light the material becomes insoluble. (6) Make a strong solution of gum arabic, and stir plaster-of-Paris in it, to make a thick paste. Apply with a brush. This takes longer to set than ordinary glue. The wood or other substance must be heated before applying. (7) Boil 1 lb. of common glue in 2 qt. of skimmed milk. (8) Indiarubber solution is a good waterproof cement. To make it, cut 1 oz. of pure indiarubber into fine threads with a sharp knife, place in a dry, wide-mouthed bottle, and add 1 oz. to 6 oz. of solvent; cork the bottle loosely and allow to stand in a warm place (away from any flame) until the rubber has entirely dissolved. If the material is too thick for use it may be diluted by adding a little more of the solvent and allowing to stand until it is absorbed. The solvent may be any of the following: Coal-tar naphtha, chloroform, oil of turpentine, ether, petroleum naphtha, bisulphide of carbon, and benzine. (9) Pour 1 pt. of vinegar into 1 pt. of milk; clear it of lumps and let it settle, then mix the whole well together. Sift in quicklime and stir to a thick paste. (10) Make glue with linseed oil instead of with water, boiling well in the ordinary way. (11) Marine glue is quite waterproof and can be recommended. The true marine glue is a combination of shellac and a solution of caoutchouc in benzole. To make it, dissolve 1 part of indiarubber in 12 parts of solvent (see above), and add 20 parts of powdered shellac, heating the mixture cautiously over the fire. Another recipe is: 1 part of caoutchouc or indiarubber is dissolved in 12 parts of benzine or naphtha with the aid of gentle heat. In from ten to fourteen days, when the solution is complete, 2 parts of asphalt are melted in an iron vessel, and the caoutchouc solution is poured in very slowly, in a fine stream and under continued heating, until the mass has become homogeneous and nearly all of the solvent has been driven off. It is then poured out and cast into greased tin moulds to harden into dark brown or black cakes. This cement requires considerable heat to melt it, and to prevent it from being burned it is best to heat a piece of it in a water-bath until the cake softens and begins to be liquid. It is then carefully wiped dry and heated over a naked flame, under constant stirring, up to about 300 Fahr. The edges of the article to be mended should, if possible, be heated to at least 212° Fahr., so as to permit the cement to be applied at leisure and with care. The thinner the cement is applied, the better it binds. (12) A good waterproof cement, which is really a marine glue, is made by melting together 1 lb. of gutta-percha, 2 oz. of linseed oil, 2 oz. of pitch, 1 oz. of shellac and 4 oz. of indiarubber. This cement should be used as hot as possible.

Mortar for Pointing.—In making mortar for flat pointing, 1 of lime or cement to 2 of sand may be used. A struck joint with the upper edge pressed in, and done as the work proceeds, is generally more durable than flat pointing.

Preparing Chlorides of Lead.—There are two chlorides of lead—the dichloride and the perchloride. The first is prepared by precipitating a solution of lead nitrate with hydrochloric acid. Or in place of the lead nitrate, acetate may be used, and common salt solution instead of the hydrochloric acid. The precipitate is heavy and crystalline, and, dissolved again in boiling water and cooled, separates again as needle-shaped crystals. To produce the perchloride, dissolve the dioxide in strong, well-cooled hydrochloric acid, whereby a yellow, strong oxidising solution is obtained. From this, water and alkalis may be made to throw down the dioxide.

Stove for Heating Six Laundry Irons.—The accompanying sketch shows a stove that is suitable for heating six laundry irons by gas. The body is made in one piece of at least No. 16 gauge sheet-iron, the pattern being a rectangle 21 in. by 15 in. Punch a row of holes along each side parallel with the burners, and bend the iron to shape; the angle at the apex should be about 90. Next cut out the bottom, allowing for folds as shown, so that it may be riveted in position; also cut out an end that will fit and completely close the back end, making an allowance round this pattern for riveting also. In the top of the end pattern cut a hole in which is riveted the end of the ventilating pipe. Next bend up angle pieces of a size convenient for supporting the heel of the iron; rivet pieces in the ends of these, and then rivet the full length to the sides as shown. Bend up two angle pieces and rivet these along the bottom, as guides for the stand carrying a pair of radial burners. Rivet the ends in the hood and the bottom, and the stove is complete.



Stove for Heating Six Laundry Irons.

Notes on Granite and other Igneous Rocks.—Under the name of granite are included many rocks differing largely in appearance, properties, and mode of origin, but agreeing in their general petrological character. The granites are all distinctly crystalline, the size of the crystals varying from a few inches in length, as in the porphyritic granites of shap, to an almost microscopic size in some of the very finely grained granites. Granite is composed essentially of three minerals—quartz (SiO_2), usually white and glassy; felspar (a silicate of alumina and potash, or some other base), often in large crystals; and mica (a complex silicate of alumina and other bases), in flaky crystals, usually of small size; scattered through the mass there are very often crystals of garnet and other secondary or accessory minerals. The colour of the rock depends mainly on the colour of the felspar and the mica. When pink felspar is present, the colour is pink; whilst when the felspar is white and the mica black, the granite is grey. The colours vary considerably, according to the proportions in which the various constituents are present. Granite is usually classed as an igneous rock; but whilst it is probable that some of the granites have been formed by fusion, there are others which have certainly been produced by the metamorphism of stratified rocks without fusion, probably under the combined influence of heat, water, and pressure. Granite is largely used for heavy work, where great durability is required, and for ornamental columns and other parts of structures, being then usually polished. It is only used as a building stone in neighbourhoods where it occurs in abundance. It is hard and difficult to work, and therefore is expensive. Granite is usually regarded as being a very durable stone; but whilst on account of its hardness it is undoubtedly good for resisting heavy wear, it does not resist the corroding influences of the atmosphere so powerfully as is often supposed. Felspar, especially the pink potash variety, yields in time to atmospheric influences, breaking down ultimately to a soft, incoherent mass of kaolin or china clay, and it is by no means uncommon to find beds of granite which have been exposed to the air for ages weathered in this manner to a considerable depth. The corrosion that has been observed in granite structures is, of course, much less, being mainly confined to a loss of the polish and a roughening of the surface, due to the corrosion of the felspar crystals. If iron be present in any form, it may accelerate decay, especially if it be irregularly distributed in the form of marcasite (FeS_2). This is indicated by the production of iron stains on the surface of the stone on exposure to the weather. As a general rule the smaller the grain of a granite the more durable it is likely to be, and at the same time the more easily will it be worked. Syenite closely resembles granite, except that the mica is replaced by hornblende; or if both mica and hornblende are present, it is a syenitic granite. The syenites are often darker in colour than true granites, and are hard and tough. Igneous rocks other than granite are not used to any large extent, except in localities where they are abundant. The porphyrites are compact rocks of igneous origin, consisting of a felspathic base, in which are crystals of quartz, felspar, and other minerals. They contain from 50 to 80 per cent. of silica, and vary in colour and in chemical and mineralogical composition. Porphyrites are mainly used in England for road metal.

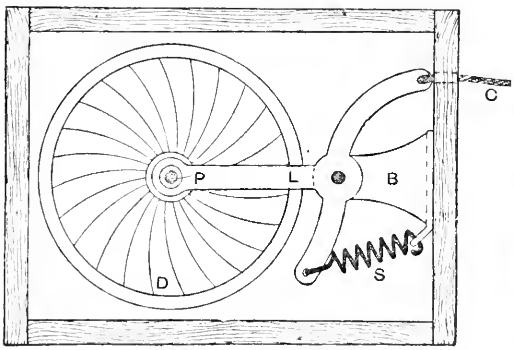
Fixing Indian Ink.—There is no method of absolutely fixing indian ink rubbed in water from the stick; alum or liquid ammonia is, however, commonly added for the purpose. Before waterproof ink was invented, it was customary to strain the sheet of drawing paper with glued edges on to the drawing-board, make the drawing with stick ink, wash it all over rapidly with a wet sponge, and then let it dry before colouring. The rapid washing took off the surplus ink without smearing, and did not materially reduce the blackness of the lines. Waterproof or fixed ink is by far the best thing to use for lines, and stick ink for washes and shading.

Testing Clock Pallets.—To ascertain whether the pallets of a thirty-hour American clock are correct, place the pallets against the 'scape-wheel teeth, with the point of one pallet against the point of a tooth. The point of the other pallet should then come midway between two teeth. If this is the case and the distance is correct, the depth will be right.

Bright Silver Plating.—Silver is deposited in a dull or matt condition, which needs brushing and polishing to become bright. For a solution to give bright deposits in special parts, place 3 fluid oz. of carbon bisulphide in a Winchester bottle, and add 3 pt. of old silver-plating solution, and shake well. Then add enough strong solution of potassium cyanide nearly to fill the bottle, and set it aside in a cool dark place for twenty-four hours. Use 1 fluid oz. of this mixture to each 10 gal. of the ordinary plating solution, and stir well before putting in the articles. A current at from 2 to 4 volts pressure will be suitable. Too much brightening solution will make the work patchy and brown. Some platers use a plating solution strong in free cyanide to put on the first or striking coat, and finish off in one containing less cyanide. Striking solutions are not always necessary.

Distinguishing Boiled from Raw Linseed Oil.—In distinguishing boiled linseed oil from raw oil, it must be remembered that the raw oil is usually of a pale yellow colour, a sweet nutty odour, and a mild taste, whilst boiled linseed oil is usually more or less brown, and has a varnish-like or burnt odour, and an acid taste.

Recording the Opening of a Door.—A little appliance devised for recording the opening of doors, etc., is shown in front elevation in the accompanying illustration. The device consists of a small clock-movement (preferably of the twenty-four hour type), the hour-wheel spindle of which is made to carry a light frame of brass or aluminium to hold a dial-card D. At one side of this dial is a standard B, of fairly stout sheet-brass, which is secured to the inside of the wooden case, and to which is pivoted a lever L, cut from sheet-brass. Attached to this is a spiral spring S, which draws downward the arm of the lever it is attached to, when a cord fixed to the end of the opposite arm is released. When the door to which the device is applied opens, a short length of soft blacklead pencil or a crayon inserted in a piece of thin tubing forming a holder on the lever at P describes a line on the dial-card. This indicates the hour of its occurrence, and also, as the dial rotates, the duration of time of such release, since the pencil-point, after moving from the centre, remains stationary at about ¼ in. from the circumference of the card until the cord is again pulled taut. In fitting it up, the case of the instrument is secured firmly to the wall behind the door. A small hook is screwed in the latter, about 1 in. from the axial line of the hinges and also on a line with the hole in the case through which the cord passes. Then, the door being closed, the cord must be of such a length as to retain the lever in the position shown in the illustration, when hooked on the door. The front of the case may be glazed if preferred. Dial-cards can be made of Bristol board, and the twelve (or twenty-four) hourly divisions should be drawn curved as shown, their radii being equal to the distance between the pencil-point and the fulcrum of the lever. Each division may be subdivided to denote halves and quarters, and numbered if necessary. Dimensions are not given, as they must be proportional to the size of the clock used.



Recording the Opening of a Door.

Pattern for Cast-iron Roller.—In making, say, a roller about 6 in. in diameter by 50 in. long, threaded with sixteen threads in 9 in. half-way round the roller, its other half having a straight thread, proceed as follows. First make a plain pattern of one-half the roller from which to obtain four castings. Allow for metal to turn off the threads and for facing at the joint. Two half castings being faced and fastened together, the parallel rings may be turned out. The other two halves being attached to each other, a double thread (a single one would not answer) may be cut. Each roller is now divided, one-half of each taken, and the pair dowelled together to form a pattern. The turner should leave a taper in each ring to enable the pattern to be easily drawn from the sand. The half pattern with the parallel rings is lifted straight from the sand; the other half is withdrawn by screwing out of the sand. As this causes the pattern to move endways in the mould, the latter must be mended afterwards, or, better, the plain neck at one end (if there is one) should be attached loosely so that it may be withdrawn first; the end motion then carries the pattern into the space left. A few rollers only may be built up of turned pieces in the manner described, a neck being arranged with collar at each end for holding the parts together. A cast screw is likely to cause trouble if required to actuate a nut. The rollers could be made of hard wood, but a special tool would be wanted for the screw-cutting lathe. Any jobbing iron-founder would make the castings if supplied with the pattern. In turning the pattern, consider the shrinking of the metal during casting, double contraction being allowed for the plain half roller.

Boxing Out Panels of Carts.—For boxing out the pillars and bottom sides to take the panels on vans, carts, etc., a right- and left-hand router, as Fig. 1, and two or three of various sizes for boxing or cleaning out, as Fig. 2, are required, as are also a few ordinary firmer chisels and a good mallet. For taking out a corner pillar on one edge only, set the iron in the grooving router (Fig. 1) to nearly the depth required, adjusting the distance on the pillar by the iron fence on the bottom; this has a stud welded into it which works through a slot in the handle, being kept in place by a wing nut on the top; run this to the depth set. With the mallet and a chisel, knock out the wood to form the rebate, using the chisel bevel side downwards, when the wood will work out quite easily; take it down to the depth of the groove, set the iron in the boxing router (Fig. 2) to the depth the recess has to be, run it along the pillar, keeping it flat on the face, when it should clean the wood out square and true. Where a rebate has to be made in a bottom side to take a panel, two grooves must be made with the router, keeping just inside the lines, chopping and cleaning out as already described, cleaning out to the gauge lines with a T-plane, trying the panel while the work proceeds to ensure a good fit.

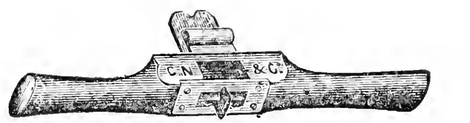


FIG. 1

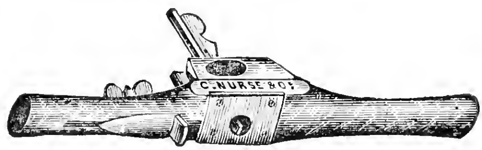


FIG 2

Router Planes for Boxing Out Panels of Carts.

Glass Embossing by the "Brushing-out" Method.—The brushing-out method of embossing glass is executed as follows. First coat the glass with asphaltum (Brunswick black). Now lay on the stencil, which is made of tinfoil. With a soft brush go over the stencil with soft soap; the latter is employed to keep the turpentine which is afterwards used from getting under the edges of the stencil. Now with a soft brush dipped in turpentine rub off the Brunswick black through the stencil; then take off the plate and wash with cold water. The work is now ready for the hydrofluoric acid to bite off.

Setting Beetles.—The following shows how beetles should be set. Place a card upon a board or cork and pin the beetle through the right wing to the cork. The legs are next extended and the card is brought up to form a rest for them; they are then fixed by a little gum. Then put away to dry, and when set release from the card by dipping into warm water; then lightly touch the underside of the feet with gum, and place upon a clean card, bearing name, date, locality, etc. The beetles may also be set by means of card braces or pins, left to dry, and placed in the cabinet with the name, etc., upon a separate card. Further information on the subject is given on p. 225.

Making a Removable Tile Hearth.—In the case under consideration it is not necessary to take out the stove before the tile hearth can be laid, and another advantage is that the hearth is easily removed when occasion requires. The tiles should each not be less than 3 in. square, but ordinary designs can now be got in 6-in. tiles; plain 6-in. tiles coloured teapot brown, buff, peacock blue, etc., to harmonise with the general colour of the room, are, however, recommended in place of the design. Fig. 1 shows an iron curb or fender that can be bought of almost any size for any ordinary fireplace. Fig. 2 is a plan of the hearth it is wished to convert, and Fig. 3 shows the curb or fender in position resting on the floor boards just up to the hearth. Two countersunk holes are first drilled through the top of the curb, as shown at A A (Fig. 3), and the curb is screwed down to the floor with two long wood screws, with the heads flush with the top of the curb. The fender or curb is thus easily removable, being secured to the woodwork of flooring by only two screws. These curbs, shown in section by Fig. 1, are about 3 in. high, so that there is plenty of room inside the curb to bed the tiles directly on to the existing hearth and leave a 2-in. projection or curb round. The curbs can be bought from about 4s. each unjapanned; they are made in a variety of designs, but a plain curb with bevelled edges looks very well. It is desirable to buy it unblacked and black it when it is in position and the hearth is laid. The tiles may now be put in their places, as shown in Fig. 5, cutting and fitting those that require it. To cut the tiles, cut through the glaze on the top with a small steel chisel about 4 in. long and ¼ in. wide on the cutting edge, and then tap smartly along this cut on the back of the tile with a small hammer. After a little practice they will be found to break quite easily. The tiles should not fit too tightly, and a space of about 1/16 in. should be at each joint. If any of the tiles require a piece taken right out of them, it is simpler to cut them straight across and then cut the small pieces off afterwards; the joint will hardly be noticed if no cement gets into it whilst laying. When the tiles have been cut and fitted, take them up and put them into a pail of water, pencilling a number on the back of each so that they may be returned to their correct positions. Before preparing the cement bed to receive the tiles, try the hearth to see if it is level. Make a "screed," as it is called, out of any piece of wood about [illegible] in. thick; cut out at each end so that the ends rest on the top of the iron curb, and the body just clears the hearth by about [illegible] in. (see Fig. 4). It will be seen that by working this backwards and forwards, keeping the ends hard down on the fender, it will screed or scrape the cement bed to a level surface, and the back part can easily be worked to the same level. Next mix up in a pail some neat Portland cement rather soft, and float over the whole of the hearth, screeding it down to a level surface. Lay all the tiles quickly and lightly on the surface of the cement, and pat them down evenly to a level surface with a piece of wood. If any of them are too low, or do not bed, they can be easily picked up with the point of a trowel inserted in the joint, and a little cement can be added or taken away as required; the tile can then be re-bedded. After the tiles are all bedded, with a rag rub some stiff cement well into the joints and then polish the tiles with a dry cloth.

FIG 1

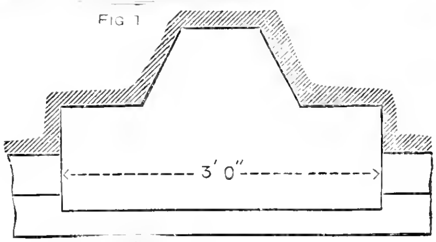


FIG. 2

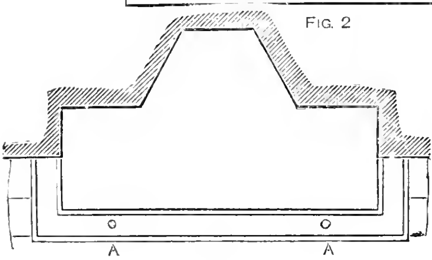


FIG 3

FIG. 4

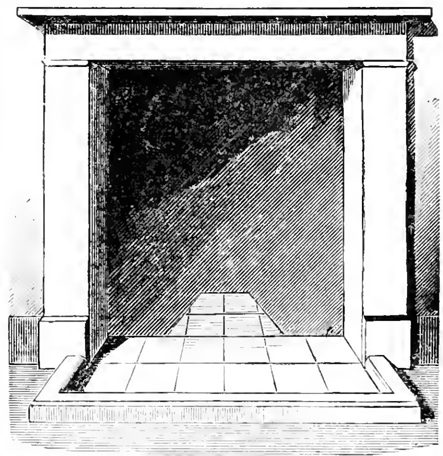


FIG. 5

A Removable Tile Hearth.

Tufting Chair Backs.—If it is required to button and tuft some upholstered chair backs the following materials will be necessary. A packet of buttons to match the covers, a ball of twine, a straight needle about 6 in. long, and a regulator. The last is a sharp-curved blade, something like the pointed end of a large packing needle, set in a wooden handle. Mark the positions of the buttons; one dozen will be sufficient for a large chair back. Now insert the point of the regulator through the canvas at the back, and work it freely all round, forming a hollow in the inside of the squab; thread the needle with twine and push it through the back, drawing it out on the front. Take up a button and push the threaded needle through the tag of the button; slip the button on the twine and pass the needle back through the stuffing, about ½ in. from the other end of the twine, so as to have the two ends of the twine at the back with the button attached on the front; tie these ends as tight as possible, and thus draw the buttons well in and throw up a tuft all round. To prevent the twine cutting the canvas when tying up, put a tufting washer, made from clippings of leather or stout cloth, between the ends before the knots are tied. To secure deep tufts, leave the ends of the twine long enough to reach the side of the back frame; a tack is knocked half-way in the wood, the ends of the twine are pulled tight and lapped round the tack, which is then driven home. The button should then lie satisfactorily.

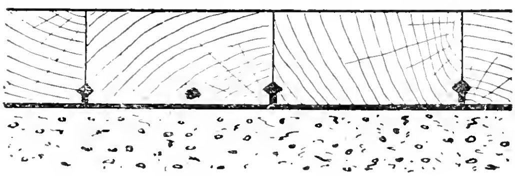
Cleaning Badger Skin.—To clean the skin of a badger, place the latter hair upwards upon the table and procure a basin of warm water, soap, sponge, and towel. Now proceed to wash the head, using no more water than necessary; do not allow water to get upon the under side. Then suck up all the water the sponge will take, and finish the drying with the cloth or towel. If this fails the skin is probably stained, and may require bleaching.

Toilet Cream for Chapped Hands.—Several materials, such as white petroleum jelly or benzoated lard, could be used for making a cheap toilet cream for chapped hands. Cocoanut oil, scented with a little oil of lavender, is a good cream. The following is a more complicated recipe. Melt together benzoated lard, 1½ lb.; spermaceti, 2 oz.; and white wax, ½ oz. Add rose water 2 oz., and oil of bergamot 1½ dr., and stir thoroughly till cold.

Dyeing Canvas or Cloth a Blue Colour.—By the indigo process of dyeing canvas, a reduced bath is made as follows. Take 10 gal. of water and add 5 oz. of finely powdered indigo, 1½ oz. of dry slaked lime, and 9½ oz. of copperas; stir the bath and keep it covered, stirring afterwards from time to time till the blue of the indigo disappears. Steep the canvas in this for two hours, then remove and hang up in the open air to oxidise. If the canvas is not sufficiently blue after exposure, repeat the dyeing process. Pass through a bath of dilute sulphuric acid (1 part acid to 20 parts water), and then wash thoroughly in clean water, without soap.

Fixing Pictures on Canvas.—The following is a method of mounting to produce the appearance of oil paintings. Make a stout deal frame, and stretch over the front unbleached calico, fastening it with tin-tacks, and taking care that all folds and wrinkles are pulled out. Now turn the picture face downwards on a newspaper, and, having trimmed to the size of the stretcher, damp the back with water. The sponge should be passed over several times until all curl is removed. When the water has soaked in well, coat the back with strong paste; then drop the stretcher down and rub well with a dry cloth on the back of the canvas. The picture should be well rubbed down at the edges of the stretcher, as a good hold must be secured there. If the edges are inclined to curl, put the stretched work face down on a clean table and place weights on top. Coat the picture with size, allow to dry, and finish with best quality paper varnish.

Mastic Asphalt for Laying Wood-block Floors.—The mastic asphalt used for laying wood-block floors is suplied in blocks weighing ½ cwt. each. A concrete foundation for the floor should be provided, and this should be brought to a true surface with a skin of neat cement. The asphalt is heated in an iron cauldron with sufficient bitumen to bring it to a proper consistency, and the blocks are dipped into the heated mixture one by one as they are laid. Sometimes a mixture of pitch and creosote oil is used instead of mastic. Such work as this is usually done by specially experienced workmen.



Wood-block Floor laid with Mastic Asphalt.

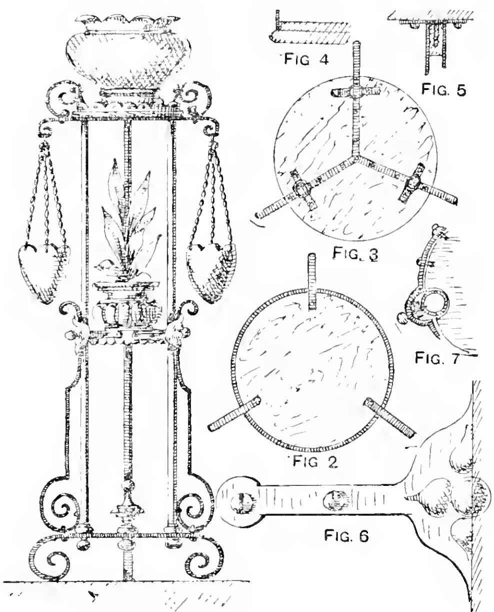
The blocks are often grooved along the sides as shown in the accompanying illustration, and the asphalt entering into this groove keys them together and prevents them from rising.

Putting Facework on Granite.—The usual faces put on in the trade (the fineness of face varying as to the price paid) are rockwork (sometimes called rustic face), punched, picked, single-axed, patent-axed, and polished faces. Rockwork is a cheap face, being left in its natural state as cloven, and merely pitched to a face line by a chisel, though exception is generally taken to any part of the rustic work being inside the pitched line of face. Some engineers also stipulate that there shall be only a certain amount of rock left on the face, as on the Tower Bridge over the River Thames and in the extension to the dockyards at Devonport, where the rock is limited to 1 in. beyond the face line. Rockwork faces have also come into vogue a great deal lately for house building, but for this class of work each stone has a margin draft run around the face, generally about 1½ in. wide. A good example of this kind of facework can be seen at Fry's Chocolate Works at Birch, the stonework for which building was worked in West Cornwall. Blocking or ashlar for big engineering jobs, such as piers, harbours, and the big masonry dams now in progress in various parts of England, are also made to a rockwork face. Punched faces are used where the faces are required to be down to a given level for various purposes, such as pavements, edge kerbs, and channelling for streets, and for stones destined to occupy places where a fine face is not required, as the quoins, heads, and sills at the backs of houses. The inside faces to small piers and harbours are generally punched. Picked faces are employed on dockwork and for coping for piers. Good examples can be seen at all docks of recent construction, notably at Portsmouth and Southampton and at the Devonport extension. The outside faces of lighthouses are also picked faces, with margin drafts. These faces can be put on at a moderate cost. The faces are first drafted around, then punched close and tooth-axed. That the tooth-axe is undoubtedly a great labour-saving tool is a fact that is confirmed by its universal use in Cornwall, whence practically all dock-work granite comes. In tooth-axing these faces, care should be taken to cross the work a good deal, or else, seeing that the teeth are in one line, the marks would appear to run in lines. Single-axed faces are slightly better than picked faces, a further operation being required, namely, that in which the single axe (or, as it is called in Cornwall, the chopping axe) is put on after having punched the face and regulated it with the tooth-axe. Single-axed faces are less expensive than the patent-axed face. They are used for steps and risers, and are sometimes put on the soffits of arch stones for bridges that have patent-axed fronts. The Broomielaw Bridge at Glasgow is an example of patent-axed fronts and single-axed soffits to the arch stones. The bedstones for heavy machinery also have single-axed faces, which make a good level bearing. Patent-axed faces are the finest that can be put on granite with tools. The first example of patent-axed faces seen in England is believed to have been at the Great Exhibition of London in 1851. Patent-axed faces vary in fineness according to the number of cuts or blades of steel in the hammers. Thus there are four-cut, six-cut, eight-cut, ten-cut, and sometimes twelve-cut hammers. These faces are first drafted around, then punched carefully off to about ¼ in. high to the drafts, carefully avoiding all holes; then tooth-axed till about ⅛ in. high to the drafts, and finally worked right down by the single axe; then, if for a six-cut face, the four-cut is run over it, then the six-cut. The mason should always be sure to single-axe right down, as the patent axe is not intended to take anything off, but simply to mark over the face in a uniform manner. If for a finer face than six-cut, the other hammers are put on in rotation until the required number of cuts is put in. The reason for putting them on in due succession according to the number of cuts is because these hammers are costly both to buy and to sharpen, and that to put an eight-cut hammer on, say, after a four-cut, would probably cause the blades to bow or to splinter up. The Tower Bridge and Putney Bridge afford good examples of patent-axed work, some of the stones having eight-cut work on them, especially on the finer mouldings to the Tower Bridge. The cost depends on the number of cuts required, as a six-cut requires one more operation than a four-cut, and an eight-cut one more than a six-cut, and so on. The cuts on the faces are put on square to the beds of the stone, and on circular work radial to the centre. The patent axes, generally called bush hammers, are sharpened on the grindstone, the blades being screwed out for that purpose. Polished faces are the most expensive. These have to be worked up to a six-cut face, the cuts being crossed diagonally to make a harder face. Then the stone is put on the machines, which rub it with iron rubbers, fed first with sand and water, then with emery, and finally finished with flannel and putty powder (oxide of tin). The greatest care should be taken, in working off the faces with the tools, that no dead hard blows are given, as these stun the stone underneath where the blow is given, and, though this cannot be detected at the time, the bruises show after the polishing has been put on.

Making Blue Mottled Soap.—The manufacture of blue mottled soap is a difficult operation. In making soap by the cold-process melt 66 lb. palm kernel oil and 33 lb. cottonseed stearin or tallow by a very gentle heat and bring the mixture to a temperature of 100° F., then stir thoroughly, and, while stirring, pour in a caustic soda lye of 65° Twaddell, at about 70° F. very slowly, taking care that it is well amalgamated. The amount of lye to be used varies from 70 lb. to 90 lb. When the ingredients have been thoroughly crutched together, pour into a frame. Now mix in a shallow trough 2 lb. of ultramarine (washing blue) with some oil until it forms a cream. With a wooden frame long enough to reach the bottom of the soap frame, the blue may be disseminated through the soap. Dip the wooden frame into the blue and place it in the soap, moving it from side to side until the soap is sufficiently mottled; then cover up the soap frame and allow to stand for three days, when the soap may be cut up.

Dyeing Green Cloth Black.—The following is a description of how to dye green cloth to a black colour. Two baths are required. For the first, 5 lb. of logwood chips and 1 lb. of sumach are boiled in 2 gal. of water and strained. For the second, 5 oz. of sulphate of iron (copperas) and 3 oz. of sulphate of copper are dissolved in 2 gal. of water. Place the cloth in the first bath and raise gently to boiling point; then wring the cloth out, place it in the second bath, raise to the boil, and boil for about half an hour; again wring out and pass through two or three lots of clean, tepid water; then again wring out, partly dry, and finally press with a hot iron.

Design for Flower Stand.—Fig. 1 shows a metal stand complete with the flower pots in position. Fig. 2 is a plan of the top, which should be of hard wood, turned circular in form, with a bead round the lower edge, as shown in section (Fig. 1). The top may be left plain, and polished or varnished, or ornamented by a strip of thin brass, having a vandyked edge, screwed round the upper portion (Fig. 1). Each tube should be the same length, a piece of wood being cut to the size of the tube and driven into it. An iron or brass plate, as shown in Fig. 5, should be screwed to this end of the tube, but before screwing on the plates a slot must be filed to allow the bracket straps (see Fig. 3) to pass through. These straps should be of strip brass ½ in. by 1/16 in. thick, curled at one end, and then screwed to the underside of the top, as shown in Fig. 3. The bottom of the pillar is a brass casting (see Fig. 1), into which the tube may be screwed at the top; on the underside is an iron screw pin, having a square centre, screwed at the one end to fit the casting, and on the other to take a knob. The scroll feet should be of strip brass 1 in. wide by ¼ in. thick, fastened in the centre by an ornamental knob and ball nut. Each of these feet should have a square hole, through which the iron pin



Design for a Flower Stand.

at the bottom of the pillar will pass and be fastened with a knob. This makes the frame rigid (see Fig. 1). The middle shelf should be of wood, with the brass strip ornamentation as before described. Fig. 7 shows the method of fixing this shelf, whilst Fig. 6 shows a repousse brass clip fastening it and the outside scrolls to the pillars. The outside scrolls at the foot should be of brass strip ½ in. by 1/16 in., fastened to the tube pillars and the scroll feet with round-headed screws. The three upper scrolls are for ornamental effect, but they also have a little tongue screwed to the top of the upper table to hold the scrolls carrying the outer hanging pots. The brasswork should be polished and lacquered. The scrolls may be bent in a vice, using a pair of round-nosed pliers for the bends and square-nosed pliers for the corners. A piece of hard wood, about 1¼ in. thick and rounded at the top, would be useful when making the scroll portions.

Hints on Oilstones.—The oilstones in most general use are four in number—the Turkey, Washita, Charnley Forest, and Arkansas. The Turkey stone is known as white, grey, or black, but generally its colour is a mixture of brown and blue shades. It is a close-grained stone, and, though not used for very fine edges, it cuts quickly and is suitable for ordinary use. It wears away rather irregularly. The Washita (Ouachita) stone is yellowish-grey in colour, and though it wears away quickly it does so much more regularly than Turkey stone. The Charnley Forest stone is of a greenish-slate colour with sometimes small brown or red spots. The lighter the colour of the stone the more serviceable it will be. Arkansas oilstone is a compact white stone resembling Washita stone, but it has a finer grain. It wears well and cuts slowly, being largely used for finishing the edges of surgical instruments. The stone should be cemented into the box made to receive it, not with white lead, but with a mixture of hot glue and dry red lead. White lead is taken up by the oil used with the stone and tends to harden its surface. When an oilstone has been in use for some time its surface is apt to become hard, especially if certain oils are used with it. The reason is that the pores of the stone are closed by the viscid or gummy oil, which contains particles of steel rubbed off in sharpening; when the stone is in this condition it is not touched by the tool, which rides upon a substance as hard as itself; therefore the stone fails to sharpen the tool. A mixture of oil and turpentine is often applied to hard stones to cause them to cut better; for this purpose, also, they are sometimes boiled in soda water. Hard oilstones may be made to give rough edges to tools by sprinkling a very little flour emery on them after the oil has been applied. Neat'sfoot oil is the very best for oilstone use, all others hardening the surface much more quickly. Soap has been recommended for the purpose. The stone is wetted and rubbed with soap and more water is applied until a lather forms. This is allowed to dry, and when the stone is required for use it is merely necessary to wet it slightly. Oils in common use for stones are sperm, olive, and sweet oil; these are often mixed with heavy petroleum. It is sometimes required to cut an oilstone into pieces, and this may be done by rubbing across it the edge of a sheet of soft iron or mild steel, using sand and water as required. Or, instead, a piece of hoop iron (such as that used on casks) may be used with emery either wet or dry as the cutting agent. Another method is to insert a piece of an old small-toothed hand-saw into a wooden block and to rub the stone on this. The teeth are, of course, set uppermost.

Details on Working Marble.—British marbles are quarried in blocks and roughly scabbled to shape on the ground; they are then taken to the sawmills and sawn to the required sizes, either as slabs or scantlings. The saws generally used are long thin blades or strips of iron about 4 in. wide and 1/16 in. thick; these are fastened tightly in a frame by means of wedges and screws. The frame is then drawn backwards and forwards, either by manual labour or by steam power, the cut being fed with sharp flint sand. After the marble is taken from the saw it is worked to the required form by means of chisels and points of various sizes, either with the hammer or mallet. Saw kerfs and chisel marks are removed, and a smooth surface produced, by rubbing the surface of the stone with iron or other hard rubbers, and sharp sand and water. The rubbers are shaped to fit the several profiles and faces. The polishing is effected by rubbing with grit stones of varying degrees of fineness, finishing with a pad of felt sprinkled with putty powder (oxide of tin). Several machines are employed for working marble, the principal one being similar to that of an iron-planing machine; marble is also turned in the lathe, the cutters working automatically. All steel tools used in working marble are tempered to a deep straw colour at the cutting edge.

Making Night Lights.—Night lights are usually made of cerasin, or of a mixture of cerasin or paraffin with stearic acid, the latter being in the proportion of from 5 to 10 per cent. These lights are moulded, the wick being placed in the mould, or afterwards put in attached to a piece of tinplate. The lights are then placed in small cardboard cases; they are used in a saucer of water. The moulds may be cast in metal; for small quantities they may be made like bullet moulds, to open into two parts; but for large quantities they may be in the form of shallow troughs with circular depressions and plungers to force the lights out after they are cold. Probably the latter method would be preferable.

Preparing Litmus and Turmeric Papers.—To prepare ordinary litmus paper, powder 1 oz. of litmus and boil it with 4 oz. of water, filter, and wash the residue with a little hot water, adding this to the filtrate. If blue litmus paper is required, cut blotting-paper into strips, dip them in the solution, and hang up to dry. If red litmus paper is required, add one or two drops of nitric acid (just sufficient to change the colour of the solution to red and no more) and dip unsized paper in this. For careful work the litmus must be purified before using. To make turmeric paper, treat 1 oz. of powdered turmeric with 4 oz. of warm methylated spirit. Allow this to stand for a few hours, when it should be filtered; blotting-paper should then be dipped in the solution and allowed to dry.

Bronzing Zinc.—To make zinc resemble brass, mix 1 pt. of best oak varnish with $\frac{1}{2}$ pt. of turpentine; well stir, and then add gradually 1 lb. of best gold bronze. When these materials are thoroughly mixed, apply with a brush in the usual way.

Making Walking Sticks from Rhinoceros Hide.—To make walking sticks from rhinoceros strips, they must first be straightened by damping and suspending from a nail with a weight at the lower end. When thoroughly dry they should be trimmed by knife, rasp, file, emery, etc., and made as smooth as possible. Now French polish them without any "stopping," thus allowing the polish to penetrate. When a good surface has been obtained and a ferrule put on, the work is complete. This produces a semi-transparent appearance, tinted by the polish, and broken abruptly by large dark, or even black, patches. The usual preservatives replace the semi-transparent appearance by a whitish opaque appearance, similar to wood. The elasticity will also suffer in the latter case.

Potash Lye for Soapmaking.—The amount of water required in making a potash lye for soapmaking depends upon the process; in the cold process very strong lyes of about 70° Twaddell are used (that is, containing 35 per cent. potash); therefore about 2 lb. of water would be required for it; but for the boiling process weaker lyes of about 14° up to 35° T. (that is, containing 9 to 20 per cent. potash) are employed; for the latter, roughly 4 lb. to 9 lb. of water would be required. Caustic potash behaves like caustic soda in soapmaking when only a small quantity is added, the bulk of the alkali being soda; but if the potash is in excess, then the result will be a soft soap.

Softening Leather Machine Belt.—A new belt may be softened by sponging it with warm water, then well rubbing it with dubbin. On the side next the pulleys give it a little castor oil now and again, and cleanse occasionally as above.

Sharpening a Boot Clicker's Knife.—The point of a clicker's knife wears away, and many workers sharpen this part only; therefore the knife gets stumpy. Sharpen the knife for a length of about 3 in., bearing most on the part near the handle. To commence, hold the emery strop on the board with the handle just raised so that the tip of the knife gets done the least. Hold the knife so that the back is worn away rather more than the edge. Have a piece of upper leather between the emery and the wood. The better plan is to have two sides of leather, and always to keep one side with old emery; thus the knife can be given a few rubs on the new stuff, and finally on leather only.

How to Make Black Harness Oil.—This is a recipe for a black harness oil. Melt 3 lb. of pure tallow without letting it boil, and pour in gradually 1 lb. of neat's-foot oil. Stir continually till cold, so that it will be thoroughly amalgamated, or else the tallow will harden in lumps. Then colour by adding bone black.

Cutting Moulds for Stone.—In cutting moulds for stone from a full-size drawing, the latter or a tracing is placed over a sheet of thin zinc (No. 9 is a useful gauge), and the profile pricked through with a fine-pointed steel scriber. The zinc is then cut to shape with a pair of tinman's shears, or cut with a small hammer and chisel on an iron plate, as near to the line as possible, and afterwards carefully filed to the required form. A long cornered chisel with a V cutting end will cut the straight edges of the mould better than the shears; by drawing the tool over the same line a few times, and bending the zinc backwards and forwards, it readily breaks off, and a few touches of the file are all that is necessary to give it a true edge.

Particulars of Red Sandal-wood.—Red sandal-wood is frequently confounded with red sanders-wood—a much better-known and commoner material. Red sandal-wood is brought to England from somewhere on or near the Malay Islands. The wood is sometimes called coral wood.

Embrocation for Sprains, etc.—This is a recipe for an embrocation for sprains and bruises. Dissolve camphor $2\frac{1}{2}$ gr., in methylated spirit 6 dr., and thoroughly mix with dilute acetic acid $2\frac{1}{2}$ oz., one-fourth part of the yolk of an egg, and 6 oz. of turpentine.

Black Drawing Ink.—The best black ink to use for drawings is China ink rubbed down by working with a circular motion and light pressure on the slab. Heating the slab or leaning heavily upon the stick makes the ink muddy and prevents it running freely. For ink that is to be used for all papers—drawing paper, Bristol board, or tracing paper—nothing should be added; but for cloth tracings a little oxgall or soap should be added, as it helps in causing the ink to flow. Also, sprinkle the tracing cloth with dry chalk and rub it well in afterwards, dusting it off to get as much of the oil out of the cloth as possible. "Artists' Black" is a liquid ink said to be specially suitable for drawings intended for process reproduction. It can be used equally well for finished drawings on cloth or other tracings; it has a dull black finish, whereas the China ink has a glossy black appearance.

Design for Oxford Picture Frame.—Fig. 1 illustrates a design for the corners of Oxford picture frames. The lozenges are level and form the top surface, the interior being carved $\frac{1}{8}$ in. deep and scored. A section of the lozenge is seen in Fig. 2, and a section of the chamfer part of the moulding in Fig. 3. For frames of large size, the length midway of the sides is relieved with an intermediate ornament, shown by Fig. 1. The moulding illustrated is $\frac{7}{8}$ in., so that for larger or smaller sizes the lozenges should be correspondingly reduced or enlarged. The frame is finished in the natural wood, being polished or varnished.

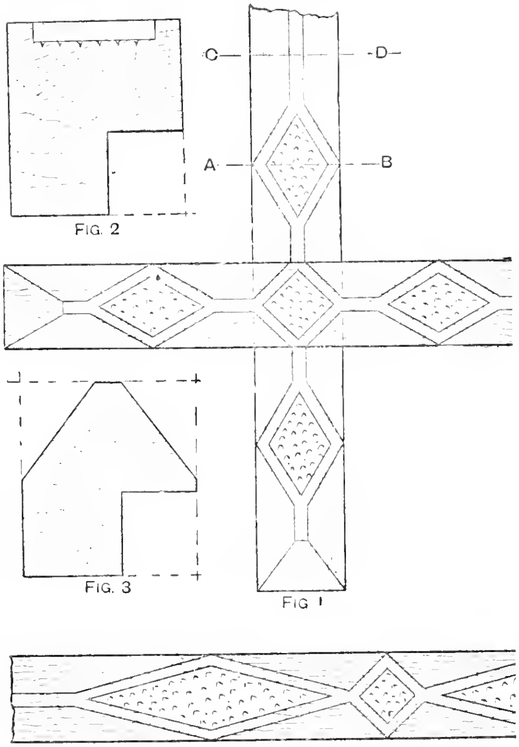


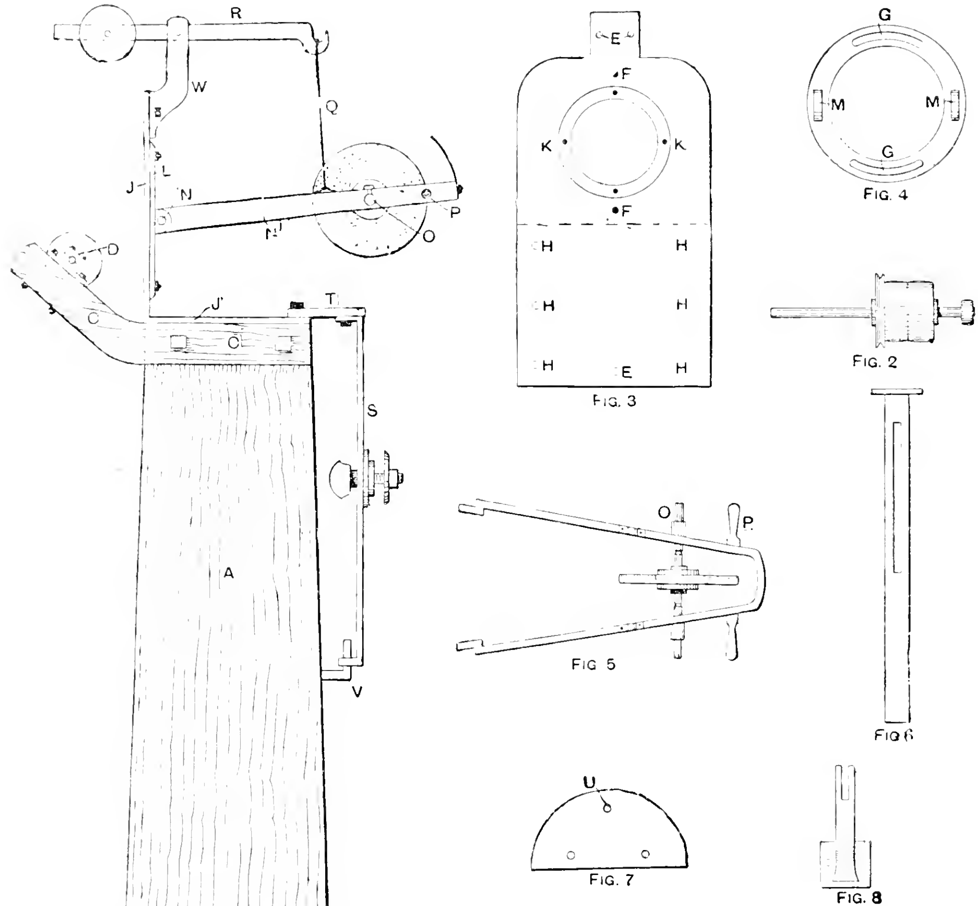
FIG. 2 FIG. 3 FIG 1 FIG. 4

Design for Oxford Picture Frame.

Plumbers' Astragal, Slip, and Expansion Joints.—An astragal joint consists of a soldered joint with ornamental mouldings, or astragals, round the pipe. A slip joint is simply one end of a pipe slipped into the end of another, which is enlarged to receive it. This is similar to that of an ordinary iron rain-water pipe. Expansion joints are of many kinds. An ordinary one is similar to a slip joint, but an indiarubber or asbestos ring is used instead of any packing or jointing material which would become hard. An astragal joint is generally used on outside lead soil pipes. Slip and expansion joints are used for waste pipes, but chiefly for those through which hot water passes.

Flat Grounds for Plate Glass.—One of the best backings for plain or blended grounds on glass is made by grinding the colour in nut oil; bind with sugar of lead; thin with benzoline. This will stand the heat or frost without cracking. A good background for fascias well protected is made by grinding the colour in milk; this is applied as distemper, stippled; a very pure colour is produced by this method.

How to Make a Saw-sharpening Machine.—The saw-sharpening machine shown in the accompanying illustrations may be made as follows. Cut from a piece of good hardwood the main standard A (Fig. 1), 12 in. square at the base and 9 in. or 10 in. square at the top. Two pieces B are fastened to it with bolts, one on each side, being also secured to sleepers fixed in the ground or to the floor-beams, as the case may be. Two pieces C (Fig. 1), 3 in. or 4 in. by 1½ in., with the grain following the curve as nearly as possible, should be cut from a piece of oak and similarly fixed with bolts to the main standard. At the upper end of each piece there is a bearing D to carry a small shaft which is shown separately at Fig. 2; this shaft has fast and loose dotted line in Fig. 3, as shown in Fig. 1. It is then secured in place. A belt leads from an overhead or intermediate shaft to the pulleys. There are set-offs on the ring at M (Fig. 1), with holes in them to receive the small pins or bolts N (Fig. 1); this ring forms the appliance for canting the swing-carriage N' (Fig. 1) to any desired angle in order to give lead to the saw teeth when they are being gulleted. The swing-carriage is made of iron, and, with the exception of the centres O (Figs. 1 and 5), handles P, and the bolts N (Fig. 1), is in one piece; there are bosses to receive the centres, which are held in place by means of small studs as shown. Between these centres the spindle that carries the emery wheel runs. The handles P P are used for bringing the



How to Make a Saw-sharpening Machine.

pulleys, and a grooved pulley for the band which drives the emery wheel. Cut out a piece of plate-iron to the shape shown at Fig. 3, bore holes in it at E E, and tap them to receive the studs, which are referred to later on. F F indicate the studs that pass through the slots G in Fig. 4. At H (Fig. 3) six holes are bored to receive the stout screws that secure the plate to the oak bearing-pieces (see J, Fig. 1). A narrow ring is riveted on the plate at K (Fig. 3); it should be small enough outside to allow the ring shown at Fig. 4 (see also L, Fig. 1) to pass over it easily, as the latter has to be revolved partially on it. The large centre hole is to allow a gut or rope band to lead to the emery-wheel washers for driving the wheel. After the plate J (Fig. 1) has been shaped, bored, etc., it is heated and bent to a right angle along the emery wheel to the saw when it is being gulleted. A wire Q (Fig. 1) passes over the hooked end of the weighted lever R, from which the swing-carriage is suspended. The emery wheel is shown in position in Fig. 5, being held in place by means of nuts screwed tightly against the grooved washers that receive the gut or rope band. The spindle of the wheel, and the centres between which it runs, should be of hardened steel. Fig. 6 is a side view of the iron bar S (Fig. 1) that carries the saw. The slot is to receive a bolt on which washers are placed (see Fig. 1), and between which the saw is secured. The slot allows saws of various diameters to be held. The bar is fixed by means of two studs to a piece T (Fig. 1), shown in plan at Fig. 7. This appliance is hung to the machine by passing the hole U (Fig. 7) over the lower stud E (Fig. 3) and the lower end over the bent piece V (Fig. 1). The saw-plate, whilst being sharpened or gulleted, bears against the straight edge of the piece shown by Fig. 7. Fig. 8 is a front view of the iron bracket W (Fig. 1) that carries the weighted lever R, which is fixed by means of a bolt. This bracket is secured to the plate J by means of

two small studs passed through the holes in Fig. 8, and screwed into the top holes E (Fig. 3). A dust-guard may be made from a piece of sheet-iron, and secured by means of a stud to the front of the swing-carriage N (Fig. 1). The machine should be given two or three coats of good paint.

How to Make Celluloid Varnish.—To make a so-called celluloid varnish the material to use is not celluloid, but trinitrocellulose, sold under the name of collodion cotton. This is soluble in amyl acetate. Acetone is also a solvent for collodion cotton, and may be used in place of amyl acetate.

Making Mechanical Dental Plates.—This is an outline of the processes and methods adopted in making a plate in mechanical dentistry. From an impression in composition make the plaster model not less than 3 in. deep from the edge of the teeth to the base. When dry, immerse it in melted stearine for fifteen or twenty minutes, then allow it to stand and dry. Press over the model some thin sheet lead, sufficient to cover the palate; take it off, cut away the edges, and try it on the model. Now flatten the lead duplicate, lay it on the metal plate, carefully mark the latter with a pencil, and cut it out with shears. Mix some casting sand, as sold at depots, with just sufficient water to bind it: if too damp, the zinc will spurt when being poured. Having thoroughly French-chalked the model all over, place it on the work-bench, base downwards; place the iron casting ring, which should be 4 in. deep and 6 in. across, on the bench encircling the model, and shape the sand well round the sides of model, pressing it down with the thumb until the ring is full. Give the ring a few sharp taps on the side with a small mallet and the model will fall out; turn it over and place carefully on the bench, and the mould is ready. Melt some zinc in an iron ladle, taking great care not to make it too hot or it will burn and become useless, and when melted pour very carefully down the sides of the mould until full. When set, knock it out, and a facsimile of the plaster model will be found. Presuming the piece of plate is ready, anneal it over a spirit-lamp, and, when cold, bend it up with a pair of half-round smooth pliers, so that it will lie on the model. Now melt lead in a ladle sufficiently deep to allow the insertion of the zinc model, which should be well oiled all over. Place it in the molten lead and allow to cool down, when it may be knocked out of the ladle, a few sharp blows with a hammer separating the zinc model and lead. The counterpart is now complete. Commence striking up by placing the metal plate between them, taking great care that it is in the correct position. Place them together on a pad on the bench, and give a few blows with a hammer of about five or seven pounds weight. Take out the plate and remove all signs of lead, and anneal it, as it becomes hard and liable to crack. Place it between the part and counterpart and strike up again, until the plate fits the plaster model correctly. The tooth or teeth, it is supposed, have been ground to fit the gum. Take a small piece of plate sufficient to cover the back of the tooth, and cut two holes in it to admit platinum pins. Having done this, cut off the pins, leaving sufficient to rivet the plate quite close to the tooth. Now file off the edges of the backing, so that none is visible, taking care that the backing is long enough to rest on the plate when the tooth and plate are in position on the model. If bands or clasps are to be attached they should be made to fit the teeth they are to embrace quite accurately, bending up with smooth pliers. Supposing the plate is 16-carat gold, the bands or clasps should be of another quality—a gold which contains a certain amount of platinum, which makes it very tough. The plate being ready and made to fit quite close to the necks of standing teeth, so as to prevent any food getting between plate and palate, place the plate on the model, the tooth in position, and the bands or clasps, taking care that these just rest on the plate; retain them in position by applying a little warm beeswax and resin mixed, and the case will be ready for soldering. Mix a little plaster-of-Paris with a little pumice-powder and water till rather stiff, and spread it on the soldering-coal. Take the plate, with attachments, off the model very carefully, and embed them in the plaster and pumice, bringing it well round the tooth and clasps, so that they remain stationary; then allow to set. Having done this, pour boiling water over the whole until every particle of wax is removed, and allow to stand and dry, say, for one hour. Place the soldering-coal in a warm place, allowing the whole to warm through; grind lump borax on a slab with water, then with a camel-hair pencil paint the parts to be united—tooth, clasps, and pins at back of tooth; cut small pieces of gold solder and place them along the line of union. The soldering requires much care, as if the flame is directed too suddenly the teeth will crack and be quite spoilt. First direct the flame all round the bedding of pumice and plaster, gradually bringing it to the case until this reaches a dull red heat; the solder will then begin to flow. Great care is required to exclude any draught or cold air coming in contact with the case, or the teeth will crack instantly. Allow to cool very gradually, remove the bedding from the coal and place in water, when it will break up; wash the case and then with small half-round files and scrapers remove any projections of solder; remove all file-marks with water-of-Ayr stone and water. Heat one tablespoonful of nitric acid with two tablespoonfuls of water in a porcelain pan over a spirit lamp, place the case in it, and it will assume its natural colour. With the circular brush of the lathe, polish first with very fine pumice and water, finally with crocus and oil. Then wash thoroughly, and the case is ready for the patient's mouth. Of course, skill in the art of mechanical dentistry plate work comes only with experience.

Straightening Ivory Walking-stick. To straighten a bent ivory walking-stick, procure a length of dry deal or pine 30 in. (or less) by 3 in. by 2 in., and along it run a straight groove with a round-nose plane the size of the diameter of the stick; secure the stick with narrow lead staples in the groove, and stand in the sun. Turn the stick in its bed daily until it is straightened.

Preparation of Collotype Plates.—The process of collotype is based upon the peculiar property of gelatine, when sensitised with bichromate of potash and dried at a high temperature, of absorbing water and refusing greasy ink in some places, whilst in others it refuses water but will take the greasy ink. The latter are those parts that have been exposed to light, the former unexposed, and there are degrees between the two. First, a reversed negative is required; this should be thin and soft, such as is suitable for bromide printing. Plate-glass several times larger than the desired picture is finely ground with emery powder and coated with a substratum of albumen and water glass; the plate has to be re-ground each time it is used. Place in a 20 oz. bottle some bits of broken glass and add 4 oz. albumen (the white of fresh eggs); 2 oz. water glass solution (commercial); and 5 oz. water. Shake this violently to a froth, allow to subside and filter through filter-paper. The ground-glass should be well rinsed to remove every particle of emery powder. Grease must be avoided, as this leads to the film tearing from its support, the greatest trouble in collotype. The plate is then coated with the substratum as in varnishing a negative, except that no heat is necessary, and it is dried guarded from dust. The plate is then again rinsed and dried, and is ready for coating with the sensitive film. Hard gelatine leads to the production of flat prints, and the soft gelatine breaks up after few impressions. Burton advises the use of equal parts of No. 1 and No. 2 (Nelson's) gelatine, and gives the following formula: No. 1 gelatine 1 oz., No. 2 ditto 1 oz., bichromate of potassium 100 gr., alcohol 1 oz., chrome alum 2 gr., and water 20 oz. The potassium bichromate is dissolved in 2 oz. water, and then ammonia is added till the solution smells. The gelatine is allowed to soften and is then dissolved by heat; the two are mixed and then the chrome alum is added in the form of 40 m. of a 5 per cent. solution. The alcohol is merely added to make the solution flow better, and should be added immediately before use. Finally filter through swansdown calico. The plate is next heated as hot as the hand can bear and held with a holder in the left hand, whilst a pool is poured in the centre. The excess is poured off, and, after a slight rocking to ensure an even film, the plate is placed in the drying oven, the thermometer on the outside of the door of which should indicate a temperature of about 120 F. Drying should take about three hours, not more. When dry, the plate is ready for printing from the negative. The two films are placed face to face in a stout pressure frame and exposed to a bright light. The negative must have a safe edge fitted as in carbon printing. Printing is judged by an actinometer, the simplest form of which is a piece of albumen paper exposed behind a thin quarter-plate negative. When printed sufficiently, the plate is laid face down on a sheet of black velvet and the back exposed for a short time to form an insoluble coating near the glass, and to prevent tearing. Development merely consists in washing the plate entirely free from the bichromate, when the lights will be found to have swollen considerably. When drying the plates care must be taken not to open the door, or drying marks may be caused. All the operations up to the coating with the bichromate solution may take place in ordinary light, and even after coating the plates are comparatively insensitive until dry. More care must, however, be taken to protect them from light than would be necessary for ordinary P.O.P. or albumen paper.

Removing Grain Marks from Ivory.—To remove black grain marks from ivory, scrape the latter, being careful to keep to the original contour. A plan adopted with valuable pieces is to engrave a design on the surface, and to fill with sealing-wax dissolved in spirit. Leave this to set, then polish off, thus hiding the objectionable marks.

How to Make Fly-papers.—In making fly-papers, melt 1 oz. of powdered resin with 3 fl. dr. of colza oil (which need not be very pure) in a small pot set on the bar of the kitchen fire. When thoroughly melted, stir well, and apply while hot with a small varnish or paste brush to old newspaper leaves.

Notes on Gesso Ornamentation.—Gesso work, to a small extent, has been employed in the decorative arts for a very long time; but it is only of late years that gesso has been recognised as a material with which effects can be obtained by simple and easily acquired methods. The possibilities of gesso for decoration are almost limitless: the material enters into the composition of panels for furniture, it forms the most effective friezes, etc., and can be employed on caskets, brackets, picture frames, and the score of fancy articles which nearly every home contains. Gesso is a kind of plaster decoration, presenting a raised and indented surface, which may afterwards be coloured. It differs from stucco, to which it is akin, in not carrying within itself a hardening principle that is awakened by mere slaking with water. Stucco hardens like plaster-of-Paris; gesso contains glue, oil, etc., for binding the chalk which is its chief ingredient. Gesso can be applied with a brush; stucco can be put on better with modelling tools. Gesso is for lower relief and finer work than stucco. The body stuff of gesso must be whiting, chalk, killed plaster-of-Paris, or something similar; hone-stone and pumice have been used. Glue, linseed oil, pitch, resin, and turpentine are employed to bind the stuff together. Very little oil is required, less resin, and still less pitch; all three may be left out. This is a reliable recipe for gesso: Mix 10 oz. of glue in 2½ pt. of water, 8 oz. of white resin in 1½ pt. of linseed oil, and 2 oz. of pitch in ¼ gill of Venice turpentine. Mix together by the aid of heat 6 parts of the glue-water, 1 part of the resin oil, and $\frac{1}{10}$ part of the pitch solution. "Gilders'" whiting that has already been crushed to a powder, or soaked and converted into a paste, must then be stirred into the hot solution; with the paste, less water will be wanted in the glue solution. When of the right consistency for application with a brush, this is called "thick white"; gilders' "stopping" is the same stuff brought to the consistency of dough, and the "compo," used for making the ornament round a frame for subsequent gilding, is gesso. Resin varnish and some kinds of driers may be used with glue and whiting to make gesso. Water and linseed oil when shaken up together form a mixture, and if to this some whiting is added, gesso is left as the water dries out. This, having the consistency of cream, is applied to the sized or lacquered wood by means of a brush. The decoration may be brought into higher relief by applying two or more coats, and, whilst still soft, the composition may be modelled with the brush. If left flat, a good ground for painting upon is formed. Some idea of the appearance of a piece of gesso work when completed can be gained by imagining a plaster cast of some figure decorated with silver and gold, and tinted with metallic colours. The effect of well-executed work is rich and harmonious. It is quite possible, of course, that instead of being harmonious it may be garish and vulgar; the worker alone is to blame if a pleasing effect is not secured.

The Preparation of Lampblack.—In producing the various grades of lampblack, soot oil, which is the last oil obtained in the distillation of coal tar freed from naphthaline as far as possible, is burned in a special furnace. In this furnace is an iron plate, which must always be kept glowing, and upon this plate the soot oil trickles from a vessel fixed above. It is decomposed, and the smoke (soot) rises into four chambers through small apertures. When the quantity of oil destined for decomposition has been used up, the furnace is allowed to stand undisturbed for a few days, and only after this time has elapsed are the chambers opened. In the fourth chamber is the very finest lampblack for lithographers' use; in the third is the fine grade employed in making printers' ink; while the first and second contain the coarser soot, which, well sifted, is sold as flame lampblack. From grade No. 1 the calcined lampblack for papermakers is produced. For preparing this lampblack, iron capsules with closing lids are packed tightly with the coarse lampblack, and the cover is smeared with fine loam. The capsules are next placed in a stove and semi-calcined, this causing the oils to evaporate and the remaining lampblack to become odourless. The capsules are allowed to cool for a few days before being opened, as the soot dries very slowly, and easily ignites in contact with air if the capsules are opened too soon. For the purpose of preparing completely calcined lampblack, the semi-calcined substance is packed into fresh capsules, these being closed up well. After a calcination lasting two days, the capsules are opened, and the lampblack, which is found to be in compact pieces, removed. For the manufacture of soot black another furnace is employed. Asphalt or pitch is thrown in through the doors, air being excluded as far as practicable, and the smoke escapes through the chimney to the soot chambers 1, 2, 3, 4, and 5, and in these chambers the soot assorts itself. The asphalt or pitch is burned up completely, and the furnace is then left unopened for several days; then the outside doors are slowly opened and air is admitted. Later on the doors can be opened altogether, if the soot black is quite cool. Chamber 4 contains the finest soot black, and this is used in the manufacture of leather-cloth and oilcloth. In the other chambers is fine and ordinary flame black, which is sifted and packed in suitable barrels. Calcined lampblack may also be produced from it, the operation being the same as for oil black.

Notes on Working Tortoiseshell.—Tortoiseshell is supplied almost entirely by the carapace or shell of the "hawksbill" tortoise, which frequents the warm waters of the East and West Indies. The shell always consists of thirteen plates, and these are generally torn apart and tied together for convenience of carriage. Tortoiseshell sells at from 20s. to 24s. a pound, and very often a single large plate will be more than 1 lb. in weight. Much time and money have been expended in endeavours to find a means of melting tortoiseshell, but without success, and so it is joined by a kind of welding process. The edges to be united are shaved and scraped to a feather edge, and laid together with a piece of fresh shell upon them; the whole is then subjected to a moist heat (as of hot water), which softens it, and it is then put under great pressure until the parts are united, after which the surplus thickness is removed as waste. Another method of welding tortoiseshell is to first file it clean, and lap one edge over the other, taking care that no grease remains, wet the joint with water, and hold it in a hot pair of pincers, so constructed as to cover 4 in. or 5 in. of the joint. Remove the pincers and apply more water, and the joint will be found secure. The pincers must not be so hot as to burn the shell. In some cases it is possible to form a good joint by cementing, and then one of the following cements is used. (1) Dissolve in 125 parts of 90 per cent. alcohol 30 parts of shellac and 10 parts of mastic, and add 2 parts of turpentine. (2) Dissolve in 58 parts of 90 per cent. spirit of wine 5 parts of mastic and 15 parts of shellac, and add 1 part of turpentine. In making tortoiseshell combs, two are cut out of one strip, and while soft a deep zigzag cut is made down the centre of the strip to form the teeth of the two combs, which thus fit closely to each other. As quickly as possible the two parts thus divided are torn asunder, as in a few seconds they would reunite. This is a difficult operation, and liable to prove costly if much waste results. To form the knobs and other raised parts seen on fancy tortoiseshell combs, the shell is heated, and while in a pliable state is gradually worked and pressed up into a mould of the required form, and subsequently smoothed and polished. Material which has been thus treated cannot be reshaped if broken, for on re-heating it takes its original form, from which it cannot be altered. Combs are usually made of more than one thickness of shell, and as many as six thicknesses are sometimes welded together. When patterns are to be carved into the work, extra thicknesses are welded on. Shell from the claws is used when a streak of unusually light colouring is required, and the under or "belly" shell, which is almost transparent, is used for the amber shell-work. In finishing tortoiseshell, it is first scraped, and then polished with pulverised charcoal and water on a woollen cloth perfectly free from grease. This is followed by water and washed chalk or whiting, the article being moistened with vinegar. Finally it is hand-rubbed with dry whiting or rottenstone. By another method of polishing, the horn is scraped smooth and level and is rubbed with very fine glasspaper or Dutch rushes, and afterwards with felt dipped in finely powdered charcoal and water. After rubbing with rottenstone or putty powder, it is finished with a soft washleather damped with sweet oil, or is rubbed with nitrate of bismuth applied by the palm of the hand.

How to Make Shaving Paste.—This is a method of making a good shaving paste. Dissolve ½ lb. of caustic potash in 2 pt. of water, and now melt 2 lb. of tallow and ½ lb. of cocoanut oil in a large pan, add the caustic potash solution gradually, and boil together. Continue boiling and stirring until a uniform paste is formed which, when rubbed between the finger and thumb with a little water, feels soapy and free from grease. Allow to cool, and determine whether the soap is thin enough for the tubes; if it is, heat the soap and fill hot; if it is not sufficiently thin, add water and boil again. Add any desired scent previous to filling. An easy way of making shaving paste is to cut any good soap into shavings and boil with about four to six times its weight of water till dissolved.

Cements for Mica.—Mica may be cemented by moistening the edges with a solution of gelatine in strong acetic acid. Another cement for mica is made by soaking gelatine in cold water and pressing out excess of moisture in a cloth. Then heat it on a water bath until it begins to melt, and stir in alcohol to form a fluid. For each pint of solution, gradually add whilst stirring ¼ oz. of gum, 1⅓ oz. of gum mastic previously dissolved in ¼ oz. of rectified spirit. Keep in stopper bottles, and warm when required for use.

Removing Dents from Brass Musical Instruments.—There are many methods of removing the bruises from brass instruments, the position of the bruise determining the method to be employed. In some cases, to avoid taking the instrument to pieces, the top of a piece of stout brass wire is soldered to the indented spot, and the brass is then pulled up. This is, however, only practicable in the case of slight dents. Where the dent is in the smaller tubings or too far round the main bow to be accessible from the bell, the instrument must be taken to pieces at the joints and the bruises removed by means of a series of steel balls of graduated sizes, which are screwed on a curved and tapered steel arm fixed in a vice. The ball should fit the bore of the tube to be trued. This is then thrust over the arm, and the bruise pressed up from the inside by the steel ball. If the dents are sufficiently near to one end of the tube, a burnisher can be employed to remove them. The burnisher has the curve of its face equal to the curvature of the tube. The burnisher is merely placed in the tube and worked to and fro over the dent until it is smoothed out.

Repairing Lead Gutters.—When stopping a crack in a lead gutter, the crack should be opened, the woodwork beneath dished, the edges of the lead dressed into the dishing, and then shaved to present a bright surface for soldering. Next drive in a few tinned copper nails to prevent the lead rising and showing through the solder; a little tallow should be rubbed on. Plumbers' solder should then be melted, poured on, and kept in a semi-molten condition by a plumbers' iron red hot. After the solder has well tinned to the lead it should be wiped flush with the lead at the sides.

Making Soluble Oil.—Soluble oil as used in finishing cotton goods may be made by mixing 2 parts by weight of castor oil with 1 part of strong sulphuric acid. The pan in which the mixing is done should be placed in a tank of water and kept cool by allowing the water to flow through the tank. Allow the mixture to stand for about a day, then add brine (salt solution); wash by stirring thoroughly, pour off the oil, and wash two or three times with brine. Now add ammonia or a solution of washing soda in small portions at a time until a portion of the oil taken out and mixed with water readily emulsifies with it.

Polishing Ivory.—Ivory may be polished by hard, medium, and soft revolving brushes with wet whiting and water, finishing with a soft polishing bob charged with dry whiting or with putty powder. To polish ivory by hand, make a pad of thick flannel or blanketing and rub with whiting and water; finish with a new pad and dry whiting or putty powder. When finished, stand in the sun to bleach, if desired.

Cleaning Windows.—Windows that are dull and smoked through being near a brickcroft are cleaned in the following manner. Slake ½ oz. of quicklime in sufficient water to make a paste, and add 1 lb. of washing soda dissolved in 1 qt. of water; mix thoroughly, and wash the windows with this. Follow with clean water, and dry with a clean cloth. A little whiting, made to a paste with water, rubbed on, allowed to dry, and then rubbed off with a clean cloth, will also be of service.

How to Burnish Photographs.—A cheap burnisher to put a glassy surface on photographs consists of a steel bar and a ribbed roller rotated by a handle; the lubricator is made by dissolving about 20 gr. of Castile soap in 6 oz. of methylated spirit. The soap may be used dry, but gives then rather more trouble. Even with a lubricator there is great liability of scratching. When marks are detected the roller must be removed, and the bar, when cool, rubbed from end to end with fine emery-paper on a strip of wood. To use the burnisher, the bar is heated, by gas preferably to spirit, till a spot of water touched on the side hisses faintly. For gelatine prints the bar must be much cooler. See that the bar and roller are parallel and at sufficient distance apart by passing through a useless print. When the card passes through just easily, without strain, insert one end of the photograph and immediately wind it through without hesitation. The slightest stop will make a dented line, which is difficult to remove. The handle must be started from such a position that it may be taken round with one continual sweep. As the picture passes, the ends are lifted slightly to impart the least possible curl backwards. A better effect is obtained if the picture is passed through from side to side rather than end to end. The film of the photograph goes against the steel roller. The photograph should not be bone dry, but, if too damp, it may blister. A certain amount of polish may be obtained by rubbing with encaustic paste, or even with white curd soap, and polishing with an old silk handkerchief. Gelatine prints are polished by drying in contact with glass, but this does not permit of their being worked up.

Writing on Opal Glass.—Asphaltum in an equal weight of methylated spirit is useful for writing on opal glass, as it will not peel. Break the asphaltum small, put it in the spirit, and set it near a fireplace for two or three hours. It may be thinned by adding spirit. Apply two coats thin, rather than one thick. Sealing wax treated the same way in spirit of wine, and applied hot, is good for polished grounds.

Quickening Combustion of Charcoal.—A method of impregnating charcoal so as to make it light up very quickly is to make a strong solution of nitre in boiling water; dip the charcoal in this, and then dry. If the treated charcoal burns too quickly, which will probably be the case, it should be mixed with some of the untreated stuff.

Renovating a Celestial Globe.—A celestial globe, the varnish of which has become chipped, is renovated as follows. Cleanse by gently rubbing with soft flannel and white curd soap, and wipe perfectly dry with clean chamois or window leather. Wipe over any scratched portions with the least possible raw linseed oil; then, if necessary, touch up defective portions with white hard spirit varnish or transparent paper varnish. Using a camel-hair brush, apply rather thinly to avoid the appearance of overlapping.

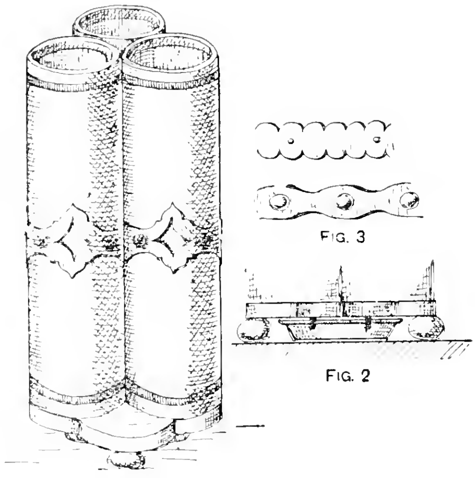
Setting Jewel Hole in Geneva Watch.—Below is a description of the method of cutting a new setting for a jewel hole in a Geneva watch. The watch plate is cemented with shellac to a brass face-plate about ½ in. or ¾ in. in diameter, run in the lathe. A spirit lamp held underneath the face-plate softens the shellac, and a sharp-pointed watch peg is then steadied upon the hand-rest and the point inserted lightly in the pivot hole as the lathe runs slowly. This centres the plate, and as the shellac hardens the plate remains true. The cutters are generally made from the tang ends of old flat files; these can be laid flat upon the T-rest, and with the aid of an eye-glass the setting is turned out to receive the jewel, the hole being opened and a slight ledge being left for the jewel to rest upon. A circular groove is then turned round the setting, to leave an extremely thin wall of brass standing up all round the edge of the jewel. The jewel is then placed in, and the thin brass edge burnished over it by a round-pointed burnisher slightly oiled. The plate is then melted off the chuck and the shellac dissolved by boiling in methylated spirit in a metal spoon over the flame of a spirit lamp.

Hints on Working the Howe Sewing Machine.—The following hints are on the working of a Howe sewing machine. First, get the machine to run backwards, or from you, quite easily; if at all stiff use paraffin oil. Thread the shuttle, first through the holes in the bottom, or under side, then under the spring in the front, or pointed end, and lastly out through the hole in the top side. The tension screw in the front is left-handed—that is, turns opposite to the direction in which an ordinary screw turns. The needle is set with the short groove towards the shuttle, and with the eye level with the needle plate, when the mark or scratch on the bar is just flush with the top of the face-plate or part containing the needle bar and foot bar, etc. If there is difficulty in obtaining needles, use a Singer arm machine needle, cloth point if for cloth work, leather point if for leather. The top cotton threads once or twice round the tension wheel, then under the small thread guide, just behind the needle bar, then in the slot in the top of the needle bar, down through the eyelet in front of spring, through the spring, back through the wire eyelet again, and through the needle, threading towards the wheel end. The stitch is altered at the screw in front of the arm, and the top tension is tightened or loosened by altering the brass thumbnut in front of the tension wheel.

Renovating Brass and Copper Articles.—It is supposed that an article composed of lacquered brass and copper requires to be cleaned, burnished, and relacquered. First remove the lacquer by brushing with an ordinary scrubbing-brush and strong boiling soda water. Then wash off with hot water, and polish with flour emery powder, crocus, and oil. Finish with dry crocus or very fine whiting. A calico dolly may be fixed to a lathe and the polishing done more easily. To lacquer, the articles must be heated equally.

Flatting Colours.—To make up flatting for calico to stand two or three coats, dry dead, and roll without cracking, take, say, 5 lb. white lead, 1 gill raw linseed oil, ½ gill gold size, ¼ lb. patent driers, and as much turpentine as will thin for working purposes. Should the first coat dry with any shine on it, use less oil; a very little of a pigment will give any tint required. Two coats at least will be necessary. For the same in distemper use whiting and jelly size; first soak the whiting in water, then pour off all superfluous water, pouring in the hot size afterwards. To each pound of size add a pint of water; a little dry colour mixed with water to a thin paste may be added to give the tint required. Two coats must be applied.

Pasteboard Tube Umbrella Stand.—The illustrations show an umbrella stand made from three pasteboard tubes. They have wood blocks fitted into the bottom, and can be screwed to the base, which is of 1-in. board. If a moulding could be worked round the trefoil wooden base, the appearance would be improved. A hole should be drilled in the wood bottom of each tube and a small pipe inserted to carry off the water from the wet umbrellas (as shown in Fig. 2). Three flattened wood balls should be screwed to the under side of the base to lift it from the floor, and to admit a tin pan underneath to catch the water. Fig. 1 shows the stand complete, with the brass ornamental

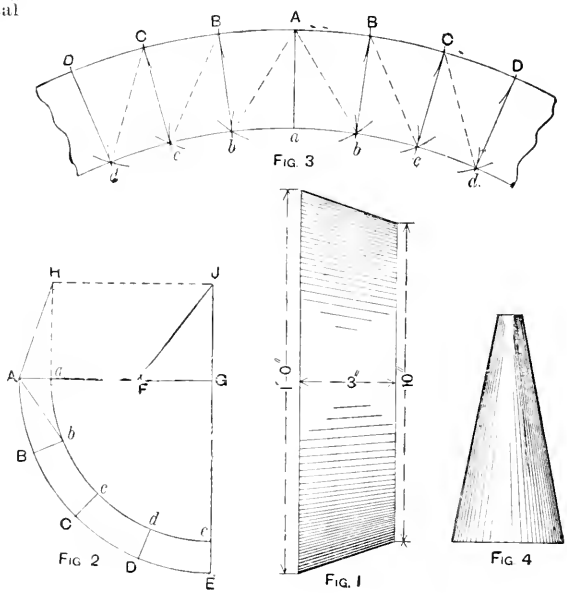


Pasteboard Tube Umbrella Stand.

rim round the centre; this may be fixed with rosettes having pins bent over when passed through the brass rims and the tubes. Fig. 3 shows patterns for the brass rims, the lower one having semi-balls hammered up at intervals. It would be advisable to fix a plate of thin zinc, say ½ in. wide, round the top inside edge of each tube to prevent the wet umbrellas saturating the upper portion of the tubes. For colouring, use a light ground, say grey, fawn, or light green, with a dark ring at the top and bottom; these colours may be applied in enamel paint.

Ferrotype Photography.—The ferrotype plate is a sheet of iron covered with an insoluble black varnish and coated first with a bromo-iodised collodion. Pour a pool in the centre, flow round the edges, and pour off at the bottom right-hand corner. When the film has set, which is shown by its dulness, it is laid face up on a dipper—two pieces of glass cemented together—and lowered into the silver bath consisting of silver nitrate 30 gr., distilled water 1 oz., and 1 drop of a 10 per cent. solution of nitric acid and distilled water. After one minute's immersion it is withdrawn, and, if wetted evenly, requires only two minutes longer. Drain and wipe the back with blotting paper, and place in the dark slide. Slides for the wet process have wires on which the plates rest, and a gutter at the bottom for drippings. Exposure is as usual, but wet plates are considerably less sensitive than dry plates. Great care must be exercised to keep the films free from dust. For development the plate is held in the hand and flooded with sulphate of iron 5 gr., acetic acid 5 c.c., alcohol 5 c.c., water 80 c.c. Fix in cyanide of potassium 2 gr., water 30 c.c. To intensify or brighten, reduce the deposit on the shadow portions, and allow the dark plate to show through more. Drops of 10 per cent. solution of iodine added to the fixing bath have the desired effect. Ferrotype cameras are fitted with a number of lenses and divisions in the camera. A repeating back—that is, a frame with a hole over which the slide passes so as to expose a portion of the plate at a time—may be used with a spring catch in the top slide rail to register positions.

Making Bevelled Stock Hoops.—Below are given instructions on obtaining the correct bevel for making 3 in. stock hoops for heavy wheels. Fig. 1 is a side view of a stock hoop, 3 in. wide, 1 ft. in diameter at the back, and 10 in. diameter at the front. First set out the half elevation, as shown at the top part of Fig. 2; then, using G as centre, with a radius of half the diameter of the back of the hoop, strike the line A E. From the same centre, with a radius of half the diameter of the front of the hoop, strike the inner line *a e*, thus obtaining a quarter plan of the part cone formed by the hoop. Divide the quarter circle as shown at B *b*, C *c*, D *d*, E *e*; also connect A and *b* by a cross line; this line measured across, and marked on the horizontal line from G to F, and connected to the vertical line at the top centre of



Making Bevelled Stock Hoops.

the elevation, will give the diagonal line to be used in making the pattern (Fig. 3). To make this, draw a vertical line A *a* (Fig. 3) equal in length to the line A H in Fig. 2. With the line F J (Fig. 2) as radius, and A (Fig. 3) as centre, describe arcs at *b b* (Fig. 3). With *a* (Fig. 3) as centre, and the distance *a b* (Fig. 2) as radius, cut the arcs at *b b* which are on the bottom of the pattern. Then from *b b*, with the length of A *a* (Fig. 3) as radius, describe arcs at B B. Take the length A B (Fig. 2) as radius, with A (Fig. 3) as centre, cut the arcs drawn at B B, which will be points on the top of the pattern; repeat this each side of the centre until several points are found, when the points can be connected by a true sweep. Fig. 3 is the shape to which the hooping must be made before it is turned round; of course, allowance must be made for bending and welding up. When making hoops as above described, an iron mandril (as Fig. 4), known also as a sugar-loaf casting, is of great assistance.

Double Image from Field Glasses.—A pair of field glasses when looked through will sometimes show a double object. This double image is due to the directions of the two optic axes not being in correct relation. This prevents the rays from the image converging upon the foveæ of both eyeballs simultaneously, two different pictures being presented, one to each eye. The remedy is to alter the direction of the optic axis of one of the telescopes forming the field glass. Probably the joining bars are bent, and so obviously they should be straightened.

Cementing Leather to Iron.—To cement leather to iron, first paint the latter with lead colour, such as white-lead and lampblack. Soak glue in cold water until it is soft, then dissolve it in vinegar at a gentle heat, add one-third of its bulk of white turpentine, mix thoroughly, and apply hot to the painted iron. Apply the leather quickly, and press tightly in place.

Making Liquid Glue.—For strong liquid glues, (1) heat together on a water bath for six hours clear gelatine, 100 parts; best Scotch glue, 100 parts; alcohol, 25 parts; alum, 2 parts; and 200 parts of 20 per cent. acetic acid. (2) Boil together for several hours 25 parts glue, 65 parts water, and 4 parts nitric acid. (3) Dissolve 6 parts of glue or gelatine in 4 parts of saccharated solution of lime; neutralise the lime with a third part of oxalic acid, and add carbolic acid as a preservative.

Burning Lead Seams with Hydrogen Gas.—Flat seams that are to be burnt can be either butted or lapped. In the former case a strip of clean-shaved lead is fed into the seam, and in the latter case the edge of the face lead is melted down into the under lap. For upright seams the lead is lapped; the face of the undercloak, and the back, edge, and front of the overcloak being cleanly shaved. No flux is necessary, as, with what may be termed clean gas, free from smoke, the lead does not tarnish. A very fine flam jet is necessary, and the seam is burned from the bottom upwards by biting off a small bead of the front lead and burning it back to the undercloak. Immediately fusion has taken place the flam is quickly taken away, and then another bead is floated down to the last one; and so on until the top of the seam is reached. Overhead work is done in a somewhat similar manner, except that a very small bead is bitten off the surface of the undercloak and floated down and fused to the face lead. Upright work is more difficult to do than flat burning, but overhead work can only be done by men who have had considerable practice.

Particulars of Hydro-extractor. — A hydro-extractor, such as is used in drying or oxidising oils on tow, consists of a circular cage or frame made of perforated zinc, copper gauze, etc., fixed on a vertical belt-driven spindle. The cage revolves at high speed and passes a current of air through the tow upon which the oil is to be oxidised. The cage is surrounded by a cover to prevent liquid being thrown out.

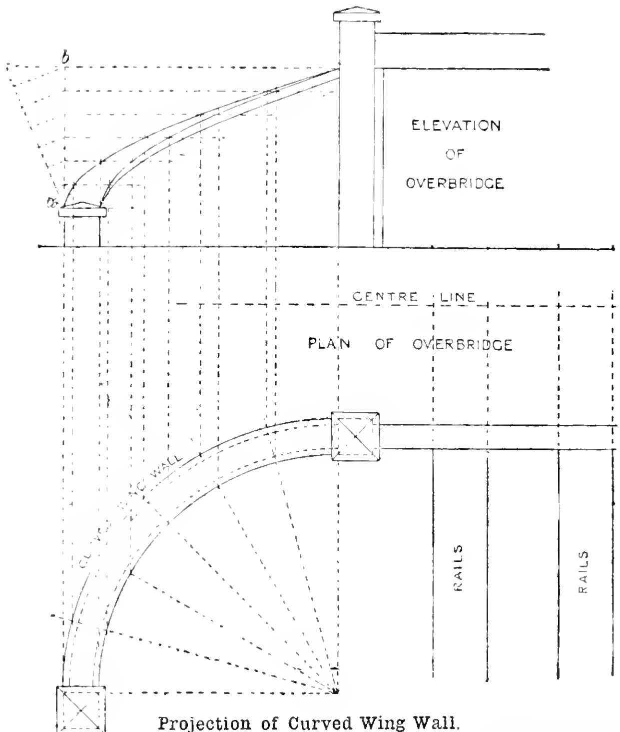
Making Bronze Powders.—As substitutes for thin films of the genuine metal, paints resembling gold, silver, bronze, etc., have long been widely employed. These paints are formed by mixing what is known as metallic bronze with a suitable medium which may be one out of, say, twenty liquids. A few of these are gum water, copal varnish, white spirit varnish, a mixture of turpentine and French polish, and a solution of collodion cotton in amyl acetate diluted with petroleum ether. Most metallic bronze powders are alloys of various metals reduced by pulverising mechanically or by precipitation by chemical agency. To make a very good gold powder, finely grind gold leaf with honey and stir with water to dissolve the latter. Change the water several times, then filter and dry. Another way to treat pure gold or gold leaf to obtain gold bronze powder is to dissolve it in nitro-muriatic acid, and precipitate it by introducing copper or sulphate of iron. In the former case the precipitate must be digested in distilled vinegar, and washed repeatedly with water. Then it should be dried. Other metals may be treated in a similar way, the desired colour being obtained by the use of basic chromate of lead, oxide of uranium, antimoniate of lead, borate of copper, oxide of iron, vermilion, or even red ochre. Mixtures of copper, tin, zinc, and iron in various proportions produce grades of yellow, orange, purple, green, and grey. Pale gold powder is a mixture of 13¼ copper and 2¾ of zinc. Red tones are produced by adding more copper. Dutch leaf has 20 to 30 per cent. of zinc and from 70 to 75 per cent. of copper, and is sometimes ground with real gold to produce bronze powder. French leaf has more zinc, is harder, and is a purer yellow. Florence leaf has still more zinc. White leaf is principally tin. The fragments from the manufacture of these metals are pounded, then brushed through sieves, ground in gum water on marble slabs for six hours, sorted, and dried. The following is a cheap gold bronze. Grind and make into a paste with oil, verdigris 8 oz., tutti powder (flower of zinc) 4 oz., borax and nitre 2 oz. each, corrosive sublimate 2 dr. This is fired and, when cold, rolled into leaves, being afterwards ground to powder. To make a copper bronze, plunge a plate of iron into a hot solution of sulphate of copper; the fine scales of copper thrown down are repeatedly washed with water, and mixed with six times their weight of bone dust. A powder having the colour of bronze, which is especially suitable for plaster, etc., can be made as follows. A mixture of 4 parts (by measure) of sulphate of copper solution and 1 part of sulphate of iron solution is added to a strained solution of soda-soap in linseed oil. The metallic soap, which is precipitated, is washed with cold water, strained, and dried to powder. This is applied in a medium made by boiling litharge with linseed oil and adding white wax. A very simple way of making gold bronze is to sprinkle powdered tin into very dilute sulphate of copper. This will throw down some finely divided gold coloured bronze. To make a red bronze, add pulverised red ochre or a solution containing chloride of antimony and sulphate of copper—12 to 20 parts of copper and 1 of tin. Another red bronze is made thus: Heat sulphate of copper 100 parts, with carbonate of soda 60 parts, until it becomes a mass; when cold, powder, add copper filings 15 parts and again well mix. Maintain at a white heat for twenty minutes, and when cold reduce to an impalpable powder, wash, and dry. For mosaic gold powder, melt equal parts of sulphur and white oxide of tin in a crucible over a clear fire. Constantly stir with a rod of glass (*not iron*) till a yellow flaky powder appears. Another way of making this powder is to use equal parts of sulphur, tin, quicksilver, and sal-ammoniac. Melt the tin in a crucible, and add the quicksilver, and maintain the heat until the mixture is of a gold colour and till no fumes of quicksilver arise. When cold, grind the combination with sulphur and sal-ammoniac. A method of making silver bronze is to melt together 1 oz. each of bismuth and tin. When tin is heated above melting point in contact with the air it becomes a yellowish-white powder, and volatilises at a white heat. Add from 1 oz. to 1½ oz. of quicksilver, and when cold pulverise the alloy. To make a dark olive-green bronze, add muriatic acid and arsenic to a mixture of orange bronze. To give some idea as to the range of colours in which it is possible to produce bronze powders, it may be mentioned that the Japanese make dark brown powder approaching black by oxidised iron; deep warm brown by different proportions of the same material; light brown by bronze; deep red by copper. They mix iron, gold, and silver, and get a blue by means of steel. Another colour is produced by equal parts of gold dust, vermilion, and charcoal. Plumbago is used to produce a black powder. The colour of the powders is affected by acids. Freshly bronzed articles are given an antique appearance by rubbing them with a soft rag or brush dipped in a mixture of ¼ oz. of sal-ammoniac and 1½ dr. of salts of sorrel dissolved in 1 qt. of vinegar.

Recipes for Various Cements.—The following are reliable recipes for miscellaneous cements. A cement for repairing an amber mouthpiece, broken in two, may be made by dissolving sufficient gum copal in ether to form a syrupy fluid. The broken portions should be slightly warmed, the cement quickly applied, and the two pieces brought closely together and bound by wire. The cement sets quickly, and the excess may be pared off with a sharp knife. Another: Heat the surfaces to be joined and apply boiled linseed oil. Clamp firmly until united. Instead of the boiled oil, a solution of potash, or a solution of mastic in linseed oil, may be employed. A cement for fixing the tangs of knife-blades into the handles is made by mixing 4 parts of resin, 1 part of beeswax, and 1 part of plaster-of-Paris, or by mixing resin with a little white sand. Put the cement powder into the hole, heat the tang, and press home. The following is a cement for mending cracked or broken glass lamps to hold paraffin oil. Mix plaster-of-Paris with white of egg and a little vinegar. Allow this twenty-four hours after applying in which to become hard. Another: Mix 3 parts of resin, 1 of caustic soda, and 5 of water with half their entire weight of plaster-of-Paris. Use at once, and allow forty-five minutes in which to set. For attaching the brass rim either of a glass or an earthenware lamp, powdered alum forms a simple but thoroughly reliable cement. Clean the rim and neck from grease, invert the rim, and fill its cavity with powdered alum, and place on the top of a hot range or stove. When the alum begins to get pasty, press the neck of the lamp firmly into place, remove from the stove, and set aside to cool. In about five minutes the lamp will be ready for use. Another: 1 part of plaster-of-Paris well mixed with 2 parts of resin soap. Zinc white or slaked lime can be substituted for the plaster-of-Paris. Another: Plaster-of-Paris worked up with a saturated solution of alum in water.

Cements for Machine Belt Joints.—The following are cements for machine belt joints. (1) Stir ½ pt. of good hot glue with a tablespoonful of glycerine and half a teaspoonful of turpentine. (2) Melt together in an old iron saucepan ½ lb. of guttapercha, 1 oz. of pitch, 1 oz. of shellac, and 1 oz. of sweet oil. Use hot. (3) Dissolve gelatine in acetic acid. (4) Add as much tannin to glue as will make it ropy. (5) Melt together guttapercha, 20; pitch, 2; shellac, 1; and linseed oil, 2 parts. (6) Digest guttapercha 3, and caoutchouc 1, in 4 of bisulphide of carbon. Belt joints should not depend entirely on the cement, but should be stitched as well.

Determining Thickness of Copper Tubing. To determine the thickness in inches of copper tubing to stand a given pressure, multiply the diameter of the pipe in inches by the working pressure in pounds per square inch, and divide by 5,600. This assumes that the copper has an ultimate tensile strength of 15 tons, and that the factor of safety is 12.

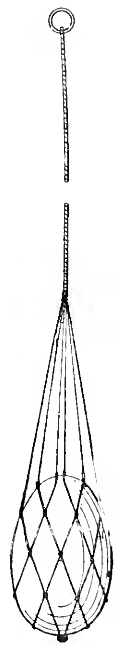
Projection of Curved Wing Wall.—The accompanying illustration shows the method of finding the elevation of a curved wing wall for a bridge. It is a helical or screw surface. Draw the plan, and divide the wing wall coping into any number of equal angles by radial lines from the centre of the curve. Where these lines cut the inner and outer edge of coping project vertical lines to the elevation. Then in the elevation set off the height *a b*, which the coping will occupy, and by means of the ordinary device of practical geometry shown on the left divide it into the same number of equal parts as the coping was divided in plan. Now draw horizontal lines to intersect with the verticals from the plan, and draw the required curve through the intersections. The visible edge of the underside of the coping is obtained by setting off the thickness vertically at each point below the curve of the upper edge.



Projection of Curved Wing Wall.

Particulars of Coal-mine Gases.—There are three mechanical mixtures of gases found in mines, and these are (*a*) air, a mixture of oxygen and nitrogen gases; (*b*) firedamp, a variable mixture of marsh gas and air; and (*c*) afterdamp, a variable mixture of nitrogen, carbonic acid, and carbonic oxide. The compound gases usually found in coal mines are four in number, and these are (*a*) light carburetted hydrogen or marsh gas (CH_4); (*b*) sulphuretted hydrogen (H_2S), sometimes called stinkdamp; (*c*) carbonic oxide (CO) or whitedamp; and (*d*) carbonic acid (CO_2) or blackdamp. Marsh gas (CH_4), the lightest of the hydrocarbons, having a specific gravity of only ·559, is a colourless, odourless, and tasteless gas. It burns with a blue flame, but will not support combustion. It diffuses rapidly in the air and forms firedamp. It does not poison the system, and may be breathed with impunity for a long time. Carbonic oxide gas, whitedamp (CO), has a specific gravity of ·967, and is a colourless, odourless, and tasteless gas burning with a pale blue flame. It is very poisonous to the system, acting as a narcotic, producing stupor and pains in the back and limbs, followed by delirium. Lamps burn brightly in this gas. It is the most dangerous gas found in coal mines, because its detection is often too late to enable its baneful effects to be avoided. Carbonic acid gas, blackdamp (CO_2), is heavier than air, having a specific gravity of 1·529. It is a colourless and odourless gas, but has a distinctly sweet taste. It is incombustible, and will not support combustion. Lamps burn dimly in air containing a small percentage of the gas, but are extinguished if the percentage increases sufficiently. Its effect upon the system is to produce headache and nausea, and finally unconsciousness, causing death by suffocation.

Device for Supporting Large Eggs.—A device for supporting a large egg can be made as follows. Take six fine silk cords and knot them together in the centre; then form a few large meshes by knotting the cords together two and two at equal distances from the first—say 1 in. to 2 in., according to the size of the object. Having formed a sufficiently large bag, knot the cords together again about 10 in. above the object and plait or twist them together, carrying them up to a picture hook or ring so that they will hang about 5 ft. 6 in. from the floor; they may then be freely handled.



Large Egg Supported in Net.

Making Plasterers' Gauged Stuff.—The fine white wall plaster known as plasterers' "gauged stuff" is made as follows. A pure, fat lime is slaked with water and afterwards thinned down to the consistency of cream. It is then left to settle, and the water is allowed to evaporate until the mixture is thick enough to work with a trowel. When wanted for use, add about a quarter of its bulk of plaster-of-Paris, and use rapidly, as the mixture is quick-setting.

Electro-coppering a Plaster Statue.—In depositing a copper coating on a plaster statue by the electrotype process, coat the statue several times with linseed oil or saturate with melted stearin to render the plaster non-absorbent to the copper salts; these would destroy the statue. When the surface is dry and firm, apply a coat of paint made of bronze powder mixed with methylated spirit only. Work this into every crevice with a soft brush, and when it is dry well brush every part with blacklead to get a smooth surface. Brush with an alcoholic solution of phosphorus, and then with an ammoniate solution of silver, prepared by dissolving silver nitrate to saturation in strong ammonia. To ensure conduction to all parts of the statue, several fine wires should be led to the deeper crevices. A battery of Daniell cells should be used, and deposition should proceed slowly to obtain a smooth coat of copper.

Making White Soft Soap.—A white soft soap could be made from cocoanut oil and lard, but it would be very expensive. The palest soft soaps are made from refined cottonseed and linseed oils. The pan for making the soap should be provided with open and closed steam coils for heating. Suppose that 100 lb. of oil be taken as a standard; this will require 22 lb. of caustic potash (82 per cent.) for saponification. This should be dissolved in water to form two lyes, one of specific gravity 1·08 (16 Tw.), the other of specific gravity 1·15 (30 Tw.). Commence with half the oil, heat up with open coil, add the weak lye, stir continually till saponified, then add the remainder of the oil and the stronger lye and continue boiling till a portion taken out is quite clear. Then turn off the open steam, and concentrate by closed steam till it sets to a jelly when placed on glass. The pan should be twice the size of the charge to prevent frothing over.

Building a Dog Kennel.—A dog kennel is illustrated by Fig. 1. The entrance hole should be about 13 in. wide by 17 in. high, the other leading dimensions being shown. Appropriate material will be ¾-in. matchboards for the sides and top, and 1-in. grooved and tongued floorboards for the bottom. The boarding of the sides and ends and the flooring should be nailed to fillets A (Fig. 3), 1¼ in. square, all round underneath the bottom. The most suitable way of connecting the sides, ends, and top is by fixing fillets as illustrated at B (Fig. 2). The top may be formed of matchboarding or plain boards, and to make it more weather-tight should be covered with felt, tarred and sanded.

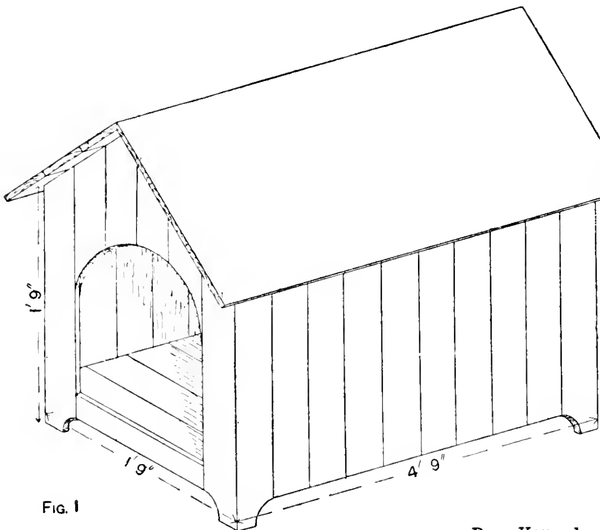


FIG. 1

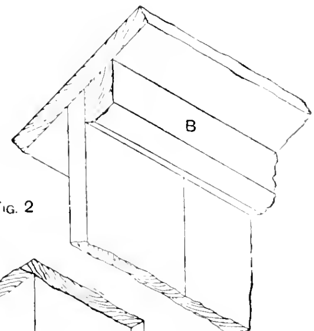


FIG. 2

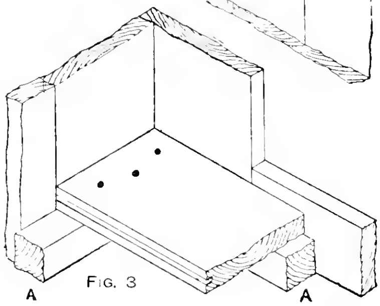


FIG. 3

Dog Kennel.

Removing Mildew Stains from Leather.—To remove mildew stains from leather, well rub the leather all over with spirit of ammonia; this no doubt will remove the stain and revive the colour. To stiffen the leather, apply on the grain side plenty of spirit of ammonia, and then well rub with a soft dry cloth, and leave to dry under pressure.

The Manufacture of Washing Soda.—In the manufacture of washing soda, sulphate of soda, prepared as described in the fifth paragraph of p. 260, is mixed with coal slack and limestone and fed into a reverberatory furnace with a revolving bed. The mass fuses, and the principal products are carbonate of soda, sulphide of lime, and carbonic oxide. The fused mass is run into iron waggons and, after cooling, the blocks are broken up, treated with water in large tanks, which are run in series, the water passing from one to the other so that the more concentrated liquor passes over new material. The concentrated solution of carbonate of soda is run into a pan placed over a reverberatory furnace, the heat from which serves further to concentrate the solution; from this tank it is gradually run on to the hearth of the furnace, where it forms a pool bounded by solid material. The flame of the furnace passes directly over the surface of the liquid and, as evaporation proceeds, the carbonate of soda separates in the solid form; it is raked out towards the fire, becoming hotter and hotter until finally it is drawn out at the furnace door, thoroughly calcined. This is soda ash, which is dissolved in a very small quantity of water and the clear liquid run into large hemispherical iron pans, where it crystallises in a solid mass like ice; this is washing soda. As will be seen, a large and expensive plant is required.

Re-dyeing Black Canvas Shoes.—In re-dyeing black canvas shoes that have worn white, well wash them, allow to dry, and then apply one or two coats of a solution made as follows. Put a quarter of a pint of methylated spirit into a bottle, then add 1 oz. of extract of logwood (2d.) and twopennyworth of tincture of steel. When dissolved, fill the bottle up with water; shake well before using.

Photographing Pencil Drawings. — Slow plates giving extreme contrasts such as are used for photo-mechanical work are the only ones suitable for use in photo-copying pencil drawings. Many workers prefer to use the wet collodion process for such work, as this, with intensification, gives extreme density and contrast. When the drawings are faintly done upon a blue tinted paper, it is practically impossible to obtain sufficient contrast, and the only plan is to make a tracing in a good black ink or ebony stain. This may then be easily photographed or copied the same size by exposing beneath it a sheet of ferro-prussiate paper.

Holding Stick Mounts while Engraving.—Engravers of stick mounts use a short length of wood, turned taper, on which the mounts are pushed tightly. Stick knobs are mounted on cement sticks about 4 in. long. When the gold or silver is very thin, the piece is made solid with cement. The article is warmed in the gas and taken off when engraved, and another substituted. Cleaning is done by throwing the mount into a bath of paraffin, where it remains till the cement is soft, when the mount is finished in successive sheet-iron boxes of boxwood sawdust, warmed, and dried by a gas jet underneath.

Dyeing Ostrich Feathers Black.—The following are instructions on dyeing ostrich feathers black. First soften the feathers by soaking them in a warm bath consisting of 1 lb. of carbonate of soda in 10 gal. of water, then rinse in clean water; they are then dyed by soaking them in a bath containing 1 lb. of ferric chloride or nitrate in 1 gal. of water. After again washing, boil them till black in a bath previously made by boiling 2 lb. of logwood and 2 lb. of quercitron bark with 1 gal. of water and straining. If a blue black is required, use 2 oz. of sulphate of copper with the ferric salt. After again dyeing, wash the feathers in clean water, dip in an emulsion made by shaking a solution of carbonate of potash with olive oil, and shake them in the air of a warm room till dried. It will be advisable first to experiment on worthless samples of feathers.

Testing Water for Impurities.—The following are simple tests for impurities in water. Add Nessler's reagent: if ammonia is present, the water will in a few moments become distinctly yellow. Add to another portion dilute sulphuric acid, and warm; while hot, add drop by drop a very dilute solution of permanganate of potash (strength 1 parts in 10,000); should the pink colour disappear even after several drops have been added, there is probably much organic matter present: if the colour of one or two drops is not discharged, the water is pretty free from this pollution. Nitrites are tested for by a few drops of sulphuric acid and a solution of metaphenylene diamine, which will yield a bright yellow colour. Nitrites usually show pollution when present, but often they are not present in bad waters; they are not important unless present in very large quantities.

Principles of Air-gun Construction.—These are some hints on the mechanism and principles of construction of an air gun. Figs. 1 and 2 explain the mechanism of two kinds of air-guns. In Fig. 1, A is a wrought-iron tube closed at one end, and acting as a reservoir for compressed air; B is the butt end of the front part of the barrel, screwing into A; C is a thick metal plate with a central hole forming the seat of the valve D; C is screwed or otherwise fixed in the bore of A, and closes it except for the valve seating; D is a cup-shaped valve, sometimes made of horn, fitting accurately in its seat in C. The fit is finally got by heating the plate C, etc., and allowing D to remain forced into its place by the air in A till all is cold. E is a spindle passing through the middle of D, of which it forms part, and sliding loosely through holes in F and G, which are two vertical metal rods, attached by each end to A and B respectively. A spiral spring keeps D pressed lightly against the seating in C. H and J are two plugs screwed into B from outside. J is bored right through, and H partly so, to receive K, which slides through J and into H. K is a round steel rod having two collars, L and M. L takes the pressure of a spring N, which forces K downwards, M preventing the latter from being forced out too far. P R is a lever pivoted to K by a pin at P, working in a slot and turning on Q, another pin attached by either end to B. At R there is friction contact with one end of E. S is a conical valve in B, kept in its seat by T, a spring pressing it upwards. The barrel to the left of B is bored smooth, and a well-fitting plunger or piston at the end of a rod is pushed in at the muzzle. The air in the barrel is forced by the plunger against D, and enters A by passing between C and D. When the piston is drawn out again, the valve S opens inwards, and lets air in to fill the vacuum. The bullet is then rammed into B. On pushing in K, the lever P R is turned on Q, and R presses on E, thus forcing D back and allowing the air to escape from A and blow the bullet out. Fig. 2 shows another common form of air-gun, A being the stock of the gun, B the butt-end section of the barrel, and C the muzzle end. The two sections into which the barrel is divided fit together accurately at D. The section B is fixed to the stock, whilst portion C turns on a pivot at E into the position shown by F. At G there is an ear to which the link H J is pivoted, and at the end J a plug or piston K is pivoted. This latter slides easily in L M, the air chamber. In O is fitted an air piston as indicated, kept in position by a piston-rod passing through a guide. Between the piston and guide is a strong steel spiral spring, which presses the piston towards the end L of the air chamber. In loading the gun the fore-part of the barrel is bent down into the position F, thus exposing the breech, and a dart can then be inserted. G comes to the position G_1, and the rod H J is forced into the position N O. This forces K back to K_1, and the piston back with it. The catch, pressed up by a spring, holds the piston in that position till the trigger is pulled. This draws down the catch and releases the piston, which is instantly forced back by the spiral spring. The rapid passage of the piston through the air chamber forces a blast through the air passage, and this blows out the dart. A spring bolt locks the barrel when the two parts are in line, but yields to the application of force when bending the barrel to load. The arrows in Fig. 2 show the direction in which the several parts move. The illustrations can be regarded only as mere diagrams; they are not drawn proportionately, and only such parts as are necessary to make the description clear are shown.

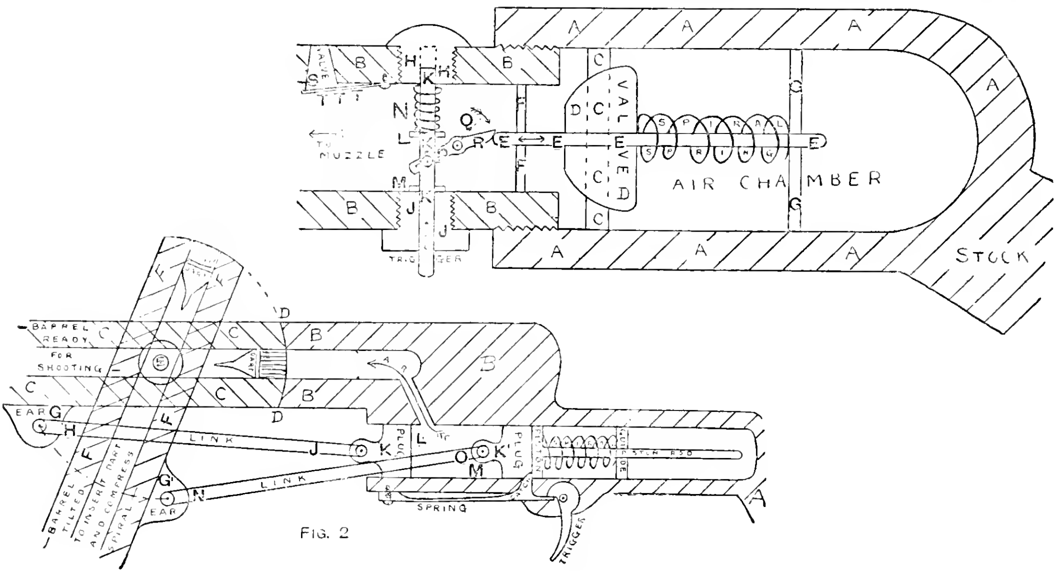


FIG. 2

Principles of Air-gun Construction.

Particulars of Basalt.—Basalt is a volcanic rock probably formed by the fluid magma escaping through some line of fracture in the earth's crust, overflowing at the surface, and then cooling slowly. Being a volcanic rock, it shows a porphyritic structure—that is, crystals are embedded in a fine-grained ground mass. This is owing to the molten magma solidifying slowly near the surface and giving time for some of the minerals to crystallise out. Basalt is essentially a plagioclase feldspar rock with augite or hypersthene, and may or may not contain olivine, thus giving basalts and olivine basalts. In the older basalts the olivine is often decomposed into serpentine, and gives an amygdaloidal structure to the rock. The minerals found in basalt are plagioclase feldspar, augite, hornblende, and sometimes small crystals of quartz and olivine. Under the microscope are seen many lath-shaped crystals of plagioclase feldspar, being easily detected with crossed Nichol prisms by its polysynthetic twining, which results in the development of a series of parallel bands of colour crossing the grain. Augite is pale brown in colour, and when revolved on the stage of the microscope, using only the lower Nichol prism, the colour does not change. Olivine is very pale green in colour, and generally traversed by cracks which are more or less decomposed into serpentine. Having a higher index of refraction than the augite, the olivine appears more prominently.

Constructing a Small Saw Mill.—Instructions on building a shed to be used as a small saw mill are here given. The shed may be constructed of old railway timbers and sheet iron. The dimensions are 55 ft. long by 30 ft. wide, with a small shed 16 ft. by 10 ft. at one end for the engine. The holes to receive the posts (P, Fig. 1) should be about 2 ft. 6 in. deep. To these posts the scantling S (see Fig. 2) is nailed, and to it the sheet iron that forms the sides of the mill, etc., is secured. The tops of the posts should be perfectly level, as the

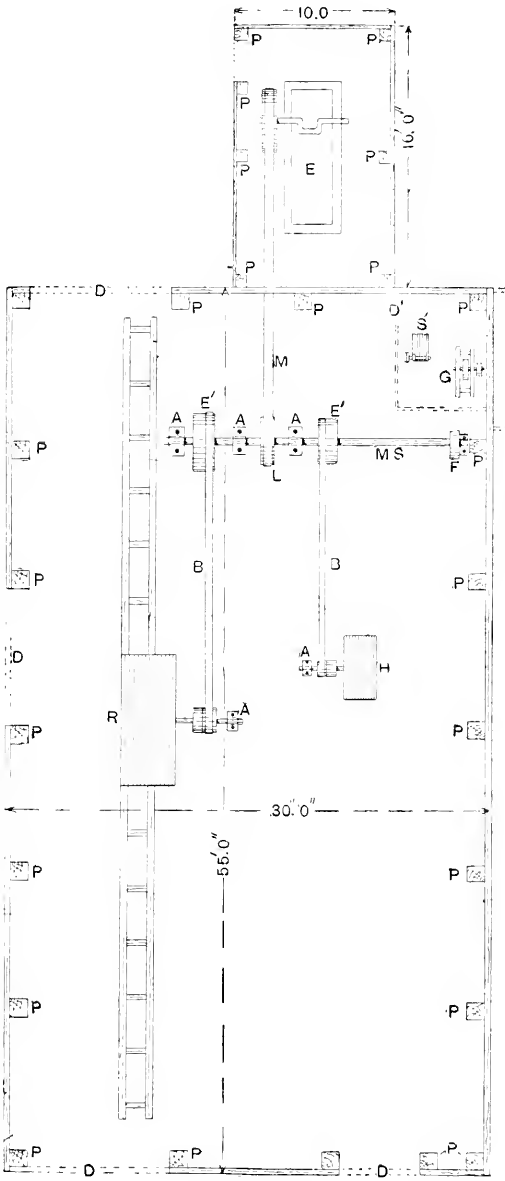


FIG. 1

wall-plates must rest on them. The roof principals are secured to the wall-plates, and the rafters are nailed to the principals, the sheet iron that forms the roof being nailed or screwed to the rafters. The engine is fixed at E, and should be of from 10- to 12-horse-power. It will be able to drive a rack saw bench in front of it, and another on the other side of the shed, and may be used at other times for running a chaff-cutter, grindstone, and saw sharpener. When the engine has been fixed, the shaft, pulley, and belt ways must be dug of suitable depth, etc., and these openings in the ground should be covered in with timber, a trap-door being placed over each bearing so that free access may be had to the bearings and pulleys. The position of each machine is shown in Fig. 1. From the engine wheel the main belt M leads to a pulley L on the main shaft M S. Belts B lead from the driving pulleys E¹ to the driven pulleys on the rack-bench R and the hand-bench H. The positions of the sharpening machine and of the grindstone are indicated at S and G. The dotted line outside the building C indicates the position of a shed in which the chaff-cutter may be fixed. The sharpening machine, grindstone, and chaff-cutter may be driven from a small overhead shaft, the end of which passes through the side of the mill into the chaff-house. A pulley is keyed on the end of this shaft, from which a belt leads to the chaff-cutter. Two other pulleys are keyed on this shaft, from which belts lead to the pulleys on the sharpening machine and grindstone. A belt leading from the small pulley F near the end of the main shaft to a pulley on the overhead shaft drives it. A dotted line at the corner shows the position of the grindstone and the sharpening machine. Small posts may be fixed in the ground here and covered with boards or sheet-iron, so as to form a sharpening house, which should be provided with plenty of light. On each side of the mill there should be at least three good-sized windows. Doorways D for each house are

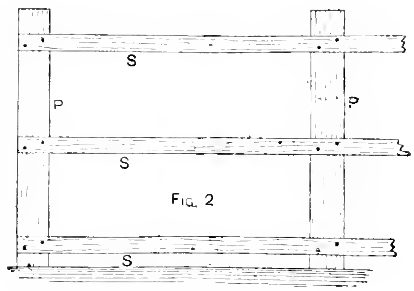


FIG. 2

Constructing a Small Saw Mill.

shown. There is a door at each end of the mill, and in line with the rack-bench, so that a rough log brought in at one door passes out at the other door cut and ready for delivery. This is a great saving of time and labour. The bearings marked A on the main shaft may be secured to blocks of wood or, better still, masonry, firmly fixed in the shaft-way. By laying out the machines in the manner indicated, there will be plenty of room for the timber that is to be sawn, and for the timber already sawn, and the stuff can be easily passed from the rack-bench to the hand-bench when it is to be sawn into small scantling. Very long timber cannot be conveniently sawn, as the length of the rack is short in such a small mill.

Making Snow-shoes. — Snow-shoes, in Northern Europe, are made of birch bark, bound to a tough rim 6 ft. long and 6 in. wide, the front being pointed and turned up. There are straps in the middle to bind the shoe to the foot. The under side is covered with reindeer skin, the hair being laid backward to prevent backsliding. Canadian shoes are shorter and wider; the sides are of tough wood, stretched apart by cross-pieces, the frame being covered with a network of gut, like a tennis racket.

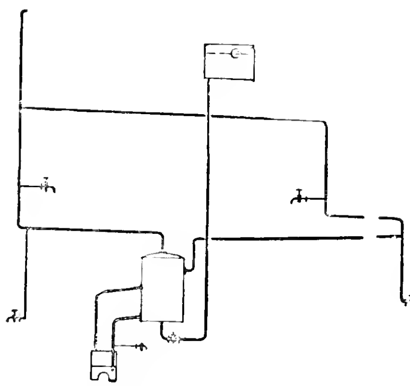
Bleaching Ostrich Feathers.—Ostrich feathers may be bleached either by exposure to the vapour of sulphurous acid, or by immersion in a solution of hydrogen peroxide; the latter method is the better one, but more expensive: the sulphurous acid may weaken the feathers. The feathers should first be immersed for several hours in a solution of carbonate of ammonia (about 3 oz. to 1 gallon of water), then washed in a warm bath made from white curd or Castile soap, passed through clean soft water, and then put in the hydrogen peroxide bath (1 part to 10 parts of water), removed, washed again in water, dried slowly, and curled. Instead of the hydrogen peroxide, a bath containing barium peroxide in solution and dilute sulphuric acid may be employed, but in this case the last washing must be thorough, or the feathers will be very tender. A pure white may be obtained by afterwards passing the feather through a warm soap bath with a little blue powder stirred in. Feathers may be dyed immediately after bleaching, or, for dark colours, without bleaching, treating them first with carbonate of ammonia to soften them.

Removing Fur from Kettle.—The only method of removing the fur from the inside of a kettle is to chip it out with a chisel or other sharp-ended tool. An efficient method of preventing the deposition of the fur has yet to be discovered. An old-fashioned remedy is to have a marble rolling about in the kettle; when this has increased in size by the deposit it may be removed and the chalky matter chipped from it before replacing.

Particulars of Olein Oil.—Olein oil is a product of the decomposition of fats by steam or by lime, being separated from the harder product, stearin, by pressure. It consists almost entirely of fatty acids, principally oleic acid; the stearin consists of stearic and palmitic acids, and is used in candle making.

Repairing Watch Balance-staff.—A new pivot can sometimes be put in a watch balance-staff by drilling a hole in the end perfectly central and straight, and inserting a piece of tempered steel, upon which a new pivot is afterwards turned. This operation requires either a watch lathe or a pair of "turns," and does not make a really satisfactory job. It is desirable to have a new balance-staff.

Cylinder System with Secondary Circulation.—A hot-water apparatus on the cylinder system, with secondary flow and return, to supply bath, lavatory, and two sinks, is shown by the accompanying figure. It will be noticed that the secondary return enters the cylinder about 4 in. to 5 in. from the top. The boiler should be boot-shaped in a 10-in. or 11-in. fire;



Cylinder System with Secondary Circulation.

35-gal. cylinder; 1-in. branch to bath, ¾-in. to sinks, ½-in. to lavatory. Primary flow and return, 1¼ in.; secondary circulation, 1 in.; cold supply, 1 in.; expansion-pipe, 1 in. The emptying tap beneath the cylinder can be ½ in. or ¾ in. The stopcock in cold supply must have a full straight-way; this pipe must be a clear 1 in. everywhere. The size of the cold cistern depends on whether the water supply is constant or intermittent. In the latter case it will depend on the establishment, but 250 gal. to 300 gal. will be a likely size.

Gold Lacquer for Brass and Tin.—A bright (cold) gold lacquer for brass and tin that will cover solder marks may be made by dissolving 1 lb. of ground turmeric, 1½ oz. of gamboge, 3½ lb. of powdered gum sandarach, and ¾ lb. of shellac in 2 gal. of spirit of wine. When shaken, dissolved, and strained, add 1 pt. of turpentine varnish.

Tonnage of Vessels.—*Under deck tonnage* is the cubic contents of the vessel below the tonnage deck divided by 100. The tonnage deck is taken to the upper deck in ships that have less than three decks, and to the second deck from below in all other ships. Length is measured from the inside of the stem to the stern timber; and for each of the following classes of vessels is divided into different numbers of parts as follows. 1st, 50 ft. long and under, 4 parts; 2nd, above 50 ft. and under 120 ft., 6 parts; 3rd, above 120 ft. and under 180 ft., 8 parts; 4th, above 180 ft. and under 225 ft., 10 parts; 5th, 225 ft. and upwards, 12 parts. Depth is taken from ⅓ of round of beam to the top of the ceiling on ordinary floors, and in others to the top of the ballast tanks, in which case the thickness of the ceiling is deducted. If the depth at the midship sectional division does not exceed 16 ft., divide it into four parts, and if it exceeds that length, divide it (and also the others) into six equal parts. The distances are then measured to the inside sparring; no measurements are taken to dunnage sparring. In oil vessels they are taken to the inside of the frames; and if a vessel is insulated for cooling purposes, to the sparring. These measurements are then put through Simpson's Rule to ascertain the cubic contents, and the result is divided by 100, which is the Board of Trade cubic equivalent for a ton, and then multiplied by 2 to complete the calculation for both sides of the ship, as one side only is measured. *Gross tonnage* is the addition of the under deck tonnage to that of the poop, or break, bridge-deck forecastle, chart house, deck houses, and hatches, if under ½ per cent. of gross tonnage. In these the tonnage is found by dividing the cubic contents by 100. Galleys and engine houses are not added. *Net register tonnage* is the gross tonnage after certain deductions have been made. These are crew space, officers' rooms, and machinery space, which includes boiler room, engine room, and tunnel. An engine store or workshop is not included in the machinery space. If the machinery space is above 13 per cent. and under 20 per cent. of the gross tonnage, deduct the tonnage of the machinery space plus 32 per cent. of it. If over 20 per cent., deduct 1¾ times the space measured. The deduction is to consist of the space actually occupied by or required for the proper working of the boilers and machinery. Engine and boiler spaces are measured to tonnage deck without light and air space. When the 32 per cent. cannot otherwise be got, the light and air space is measured and added to the gross tonnage and to the machinery space. Light and air space is engine and boiler casings and engine skylight measured above the tonnage deck. The following examples will show how this works out.

Tonnage for three-decked ship with laid decks:—

Under deck	1,928·81
Poop	132·04
Forecastle	55·68
Houses	87·87
Excess of hatches	2·24
Gross Tonnage	2,206·64
Deductions:—	
Propelling space	706·12
Crew space	77·11
Total deductions	783·23
Gross tonnage	2,206·64
Deductions	783·23
Net Register Tonnage	1,423·41

The tonnage co-efficient is the tonnage divided by length multiplied by breadth by depth, divided by 100. Example:—

The tonnage is 2,310:—

$$L \times B \times D \div 100 = 2{,}951$$

2,951) 2,310

0·78 co-efficient

Polishing Shells.—Generally, shells to be preserved and polished may be divided into (*a*) those having a natural polish and requiring very little preparation; (*b*) those which have no natural polish, but which may be polished without much trouble; and (*c*) rough shells which require to be smoothed by mechanical means before polishing. Some of those in the first class, especially when found with a glossy surface, look well if merely cleaned; with others the colours and polish will not be so bright when dry as in a wet state, so they are coated with gum water, white of egg, or colourless transparent varnish. The polish and colour of some shells is obscured by a dull epidermis or outer skin, to remove which, soak in warm water and rub off with a brush or a rag dipped in hydrochloric acid; afterwards, well wash the shells in water and proceed as before. If, after removing the skin, the shells have no natural polish, they constitute the second class. Next wash them well in warm water and dry in hot sawdust; some may be polished by simply rubbing with chamois leather, with or without a little olive oil. Others are smoothed with emery-paper, rubbed with washleather dipped in turpentine and dressed with tripoli powder, then with fine tripoli alone, and finally with olive oil and chamois leather. All rough shells should first be boiled in a strong solution of potash. Ordinary files, followed by emery-cloth, will remove the roughness of some shells, which can then be polished in the way mentioned for the second class. Others must be ground with emery-wheels of different degrees of fineness, or wooden and other discs dressed with washed emery, rottenstone, and water; or the disc may be covered with leather dressed with putty powder or tripoli. Sometimes, in grinding shells, the outer stratum or strata is ground through to show the underlying ones

Recipes for Universal Cements.—Under the name of universal cements are known many useful preparations that strongly adhere to almost any substance—wood, metal, leather, glass, etc. This is a recipe for such a cement, and it is especially useful for repairing specimens of minerals, rocks, etc. Reduce 2 oz. of clear gum arabic to powder, and dissolve it in a little water. Dissolve 1½ oz. of fine starch and ½ oz. of sugar in the gum solution, and heat the mixture over a water-bath until the starch becomes clear. The cement should then be as thick as tar, and should remain so. It can be kept from spoiling by dropping in it a lump of camphor, or a little oil of cloves or sassafras. There are two universal cements that appear in the form of brown sticks: (*a*) shellac; and (*b*) a mixture of 2 parts of shellac and 1 part of Venice turpentine. These materials are melted and then cast into sticks. Another universal cement is made thus:—Dissolve 8 oz. of sugar in 24 oz. of water in a glass flask on a water-bath, and to the thin syrup add 2 oz. of slaked lime. Keep the mixture at a temperature of about 70-75° C. for three days, shaking frequently; then cool, and decant the clear liquor. Mix 6½ oz. of this liquor with the same quantity of water, and in the mixture steep 16 oz. of fine gelatine for three hours after heating, to effect solution. Finally, add to the mixture 1 oz. of glacial acetic acid and 15 gr. of pure carbolic acid. The latter serves as a preservative. Another: dissolve 2 oz. of isinglass or fish glue in proof spirit, and add 1 oz. of pulverised gum ammoniac. Mix with a saturated solution of 2 oz. of mastic in alcohol, heat over a slow fire, and afterwards place in well-stoppered bottles. For use, the material should be heated. This is especially suitable for china and glass.

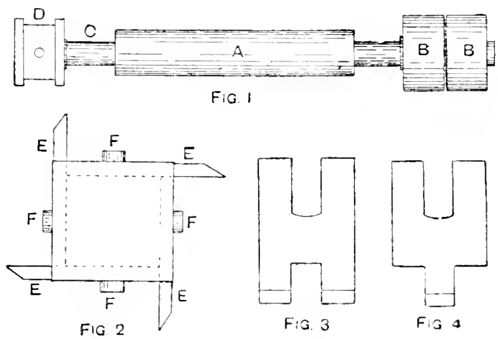
Cleaning Gravestones.—The method of cleaning gravestones by scraping and rubbing with sand and water is one of the most thorough that can be adopted. Chloride of lime may often be used with advantage; a paste made of American potash and whiting is also useful for the purpose.

Testing Drying Quality of Paint.—To test the drying qualities of paint make some streaks of paint on glass slips and keep them at, say, 212° F. for about half an hour; the quickest drying will be the most tacky to the touch. In ordinary circumstances, the amount of white lead required for 1 lb. of driers varies from 10 lb. to 14 lb.; more will be necessary in summer than in winter. Too much driers will cause the surface of the paint to dry too rapidly, the result being the formation of a hard surface film and a tacky basis. For lead colour it would be advantageous to use more driers, as the black retards the drying considerably.

Varnish for Kitchen Chairs.—Before re-varnishing, the chairs should be washed with soda water—a teacupful of soda dissolved in 1 gal. of warm water. Use a good quality spirit varnish. The more shellac the harder the varnish; soft gums, as elemi, thus, or Venice turpentine, should be discarded. For mahogany or stained chairs use garnet or button lac in preference to shellac; for light or birch chairs, use lemon shellac. A good useful varnish consists of button lac 4 oz., resin 2 oz., benzoin 2 oz., and methylated spirit 1 pt. Carefully strain before use; keep corked when stored away; apply with a camel-hair brush. One pennyworth of Bismarck brown to 1 pt. of varnish will impart a rich red tone, though the better plan would be to colour all light places with equal parts of varnish and spirit strongly tinged with red, then finish with clear varnish.

Notes on Damp-proof Courses.—Damp-courses, or damp-proof courses, as they are correctly termed, are inserted in buildings to prevent the damp from entering the upper portion of the walls. The wet can get into walls in three ways, namely, (1) from the top, this being avoided by building a coping of hard bricks set in cement, and a course of tile creasing. (2) From the front, this being prevented by rendering with cement, hanging with tiles, and by other methods. (3) By capillary attraction from the foundations, when these are laid in wet or damp soil, or when the top soil becomes soaked by rain. It is to the last-mentioned conditions that damp-proof courses are applicable. Water is prevented from getting, by means of capillary attraction, into the upper portion of buildings, by inserting a layer of some impervious material about 3 in. above the ground level. Asphalt is the best material that can be employed, as if any slight settlement should occur asphalt easily conforms to it without cracking; it should be used in two layers, making altogether about ¾ in. in thickness, so that any joins or faults in one layer may be covered over by the next. Sheet-lead makes a very good damp-proof course, as it entirely prevents any moisture from getting higher up the building; besides, it is pliable, and does not crack if any part of the wall should settle slightly more than another part. It is, however, too expensive for general use, and must be laid in cement, as ordinary lime mortar corrodes it very quickly. A stoneware damp-course of about 3 in. thick can be obtained with holes perforated through it so that it can also be used for ventilation purposes. It costs more than asphalt, but it has the advantage of raising the building 3 in., thus saving one course of bricks; this may be deducted from the cost. Slates laid in cement are often employed as a damp-proof course; this, if the slates are laid in double courses so that each joint is covered by a slate, forms a very good damp-preventer and is very cheap. It has the disadvantage, however, of being easily cracked, and this lessens its efficiency. A course of Staffordshire blue bricks can be built in the wall as the work proceeds, and these, if laid in Portland cement, make a very durable, permanent, and cheap damp-proof course.

Machine for Grooving Sashes.—Below are instructions on making a small machine for grooving, rebating, and moulding sashes and similar woodwork. Fix together a strong frame as for a small hand circular-saw bench. Two bearings secured to the frame may carry a spindle with a grooved cutter-head D (Fig. 1). On the frame is secured a portable table, hinged at one end so that the other end may be raised; or it can be raised both ends to vary the depth of cut; or it may be screwed to the frame, and the cutters adjusted by easing the studs that secure them to the cutter-head, the studs being screwed into tapped holes in the head. A (Fig. 1) is the spindle, and at B are tight and loose pulleys, and at C the parts that run in the bearings. These should fit nicely and run freely. Fig. 2 is an enlarged end view of the cutter-head, showing the cutters E secured to the head.



Machine for Grooving Sashes.

At F are the studs that secure the cutters to the head. There should be a suitable opening in the table for the cutters to pass through, and two small pressure rolls immediately before and behind the cutters to bear on the stuff to be worked. These cutters should be driven at a high speed. The higher the speed, without vibration, the better the work done. In the same bearings a saw spindle carrying a small circular saw may run. The table and spindle referred to above should be removed, and another table with a saw-gate in it for the passage of the saw should be screwed on the frame. Suitable saws may be used for tongueing and grooving, or cutters, as Figs. 3 and 4, may be secured to the cutter-head. When grooving, use a long fence, to which the pressure rollers should be secured. Suitable cutters for moulding, grooving, etc., may be obtained from makers of woodworking machinery. The work in such a small machine may be fed by hand.

Manufacture of Acetate of Cellulose.—Acetate of cellulose is made by a process patented by Cross & Bevan and described in patent No. 9676, 1894. The method is as follows. Dehydrated cellulose is mixed with a concentrated solution of zinc acetate in equal proportions; the mixture is then dried at 110° C., and finely powdered. The powder is mixed in small quantities at a time with acetyl chloride, the proportion being 2 parts of acetyl chloride for each part of zinc acetate used at the first. The mixture is well stirred and cooled, so that the temperature never rises above 30° C. When the reaction is completed the mass is washed with water to remove the zinc salts and dried. To free it from unaltered cellulose, the product is treated with chloroform, which dissolves the cellulose acetate, and, after filtering, the solution is heated; the chloroform then distils over and is collected, and the cellulose acetate is left as a transparent film or sheet.

Dulling Varnished Surfaces.—To dull a varnished surface proceed as follows. With a sash tool apply raw linseed oil over all the varnished surface. Then take up a quantity of medium grade pumice powder on a fairly stiff bristle shoe-brush of good quality, and apply liberally and with plenty of friction, more oil being added if necessary. Should it be found that the varnish is too hard for the pumice to cut, a small quantity of emery powder may be added. As the surface becomes dulled, cease to use the oil, and use the pumice drier. Finally, finish off with a drier brush and plenty of clean rag, in order to leave the surface free from grease. Excess of oil, or a greasy appearance, may be killed by wiping over with benzoline. Best "antique" goods are often dulled with pumice or emery as advised above, and afterwards finished by a sharp rub of beeswax and turpentine, which imparts a pleasing gloss instead of a shine.

Rifle and Belt Racks for Tent Pole.—Figs. 1 and 2 show an elevation and plan of a rifle rack for a tent pole. The rack is made of birch or beech wood 1 in. thick by 2½ in. wide, jointed in the centre by a hinge A on the front edge. A semicircular groove is cut on the back edge, a hoop-iron plate B (Fig. 2) being fixed on each side, so that the projecting ears C are ½ in. apart. A ¼-in. bolt, having a small wing nut fitted on the end, passes through both

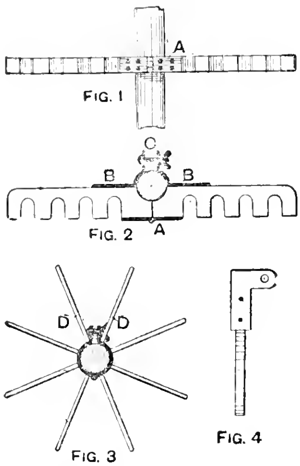


FIG. 1 FIG. 2 FIG. 3 FIG. 4

Rifle and Belt Racks for Tent Pole.

ears; this nut, on being screwed up tight, fixes the rack in any position on the pole without damaging it. For suspending belts from a tent pole, an iron clamp made to Fig. 3 to encircle the pole is required; it is jointed in the front to allow of it expanding so that it will take off and on, and is fixed at the back by a bolt in a similar manner to the rack (Figs. 1 and 2). To take the bolt, it will be necessary to turn down the ears as shown in Fig. 4, otherwise the bolt will be in the way of the pegs D (Fig. 3). These pegs are about 6 in. long by 5/16-in. round iron, and are riveted into the clamp.

Roofing with Felt.—A small building may be roofed with felt alone in the following manner. The felt is placed upon horizontal battens which are sawn from the round trees, the edges being left rough, and the battens being placed with from 3 in. to 4 in. between them. The felt is put on from ridge to eave, passing over the ridge to the middle of the nearest batten. The felt is hooked or lapped to give four thicknesses, through which the nails can go. This roof will stand the test of many years, not a drop of water coming through, and is light, cheap, and strong.

Fixing Topmast of Flagstaff.—In fixing the topmast of a flagstaff to a mainmast it must be remembered that the masthead, that is, the portion between the two caps, or brackets, is square and slightly tapered, and the caps fit tightly on it, one at the top and the other on the cheeks below. In small flagstaffs, where housing the topmast is unnecessary, the other holes are usually round, the heel of the topmast being round also. After the topmast is hoisted, it is wedged in position, and a fid bolt put through the heel resting on the lower cap; these light poles are not provided with stays. Larger staffs have a sheave-hole in the heel as well as a fid-hole, and the upper cap is fitted with iron bolts, to one of which the end of the mast rope is hitched. The hauling part is passed through the sheave-hole, and through a block hooked on to the other cap bolt. A slack lashing is put round the topmast and hauling part of the mast rope about one-third down, a sailor goes aloft and points the mast, and when the topmast head is well through the upper cap he puts on a grommet (to prevent chafe), and then the stays; he then fixes the truck, and reefs the signal halyards. When the mast is hoisted, he puts the fid in; the mast rope is then slackened, and stays are set up, etc. Lowering, or housing, is performed in the reverse order.

Making Glauber's Salt.—The Leblanc method of making Glauber's salt (sulphate of soda) is as follows. Common salt in fine crystals is fed into a large iron still connected with several tall towers made from drain pipes, down the interior of which water is allowed to run from the tank. The requisite quantity of oil of vitriol is then run into the pan and, after the first reaction has ceased, heat is applied until all the hydrochloric acid has been evolved and the residue is a neutral sulphate of soda. The hydrochloric acid is condensed by the water in the pipes and recovered. The sulphate of soda is dug out of the pan. When this is dissolved in water and crystallised out, it is known as Glauber's salt.

Underpinning a Chimney Breast.—In removing a chimney breast (on ground floor) and in fixing cantilever brackets to support three floor breasts above, a steel joist, 1 in. in depth for each foot of span, should be fixed

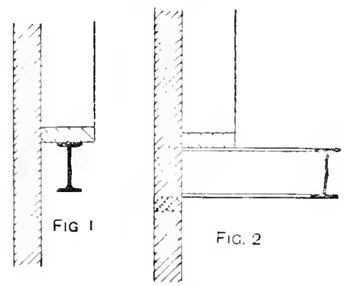


FIG. 1 FIG. 2

Underpinning a Chimney Breast.

parallel to the wall, as shown by Fig. 1, with a strong 4-in. flag on the top under the breast; or two similar joists should be fixed at right angles to the wall and carried across the room as shown by Fig. 2, with a similar flag carrying the breast. The latter method would be the safer, but it necessitates two beams instead of one.

Mending a Watch Fusee Chain.—Here are instructions on mending the fusee chain of a lever watch. Lay the chain on a piece of wood. Place the nail of the first finger of the left hand on the last link, and insert the edge of the small blade of a pocket knife and raise the link just enough to start the rivet and show where it is. Then place the chain over a steel stake with graduated holes, and push out the rivet with a flat-ended needle held in the pin-vice. Treat both ends of the chain in this manner, making them match each other. Now file up a smooth steel pin to form a new rivet, and tap it in gently. Cut it off as close as possible to size, lay it on the wood, and file the rivet flush on both sides. Now lay the chain on a flat steel stake and gently tap the rivet on both sides with a light watch hammer. When finished, the join should not be perceptible.

Concrete Construction under Water.—To form concrete walls under tide level, the most practical way will probably be to work inside a timber cofferdam, if the depth is not too great. The wall would be dealt with in short lengths. If it is wished to dispense with a cofferdam, the concrete can be deposited by means of cranes and special skips, which have doors at the bottom arranged to open when the bottom of the sea is reached. The concrete is thus deposited quietly in position, and if the currents are not strong, the cement is not washed out before it has time to set. Another way, used in the construction of piers of breakwaters, is to sew the freshly made concrete up in long bags, like sausages, and then drop them into position. The bags protect the cement from being washed away. This method could only be used if the wall were very thick, and could not be depended on to make a water-tight wall.

French Polishing Turned Teak.—Teak-wood blocks, turned at high speed in a lathe, are generally left with a smooth finish; they are oiled and polished whilst revolving. If the blocks are rough or coarse grained, a filling of tinted plaster-of-Paris is ofttimes used previous to oiling. A suitable polish consists of methylated spirit ½ pt., gum sandarach 1 oz., seed lac 1 oz., gum benzoin ½ oz., and English beeswax 1 oz. shaved thin and dissolved in sufficient turps to make a paste. When the other gums are dissolved, add the beeswax and carefully strain. Apply with a flannel or pads of soft wadding.

Thinning Stockholm Tar.—Stockholm tar that has been kept for a long time and has thickened may be melted down by a gentle heat, and thinned either with creosote oil or with coal-tar naphtha; this will require very great care, especially if the latter be used, the materials being very inflammable. The tar may be applied cold if sufficiently fluid; but for treating wood it is better to apply the tar hot, because then it penetrates much better.

How to Make Leather Purses.—To make the purse illustrated by Fig. 1, first cut a cardboard pattern, and mark and cut out the leather for the back piece A (Fig. 2), which is on a smaller scale to Fig. 1. B (Fig. 2) is the front piece. A slit or small hole H (Fig. 1) is made in the front piece, and a collar-stud is inserted, or a button may be sewn to the leather. The back and front pieces are then sewn together round the edges, the flesh sides being innermost. The dotted lines D (Fig. 1) represent the stitches. The edges of the purse should be rubbed smooth, and a slit S (Fig. 1) made in the flap to fasten on the stud or button. Instead of a stud or button to fasten the flap of the purse, a piece of leather L (Fig. 3) can be sewn on, under which the flap F (Fig. 3) is pushed. Leather divisions can be added to these purses if desired. Fig. 4 shows a different shape of purse. To make a purse that opens wide, a piece of thin leather, Fig. 5, is sewn to the sides and bottom.

Executing Designs in Gesso.—Those attempting gesso work for the first time should, to get familiar with the work, colour a panel of wood green with metallic colours. Brush the gesso upon the green ground and model the design; let it dry, then silver it, adding touches of gold to bring out the pattern. Or the design may first be sketched on the panel, the gesso laid and modelled, then the background laid in, and, lastly, the gesso silvered and gilded. This is one of the simplest styles of panel that can be executed. Good ideas for designs may be obtained from some of the best Japanese papers. Large scrolls, arranged on decorated backgrounds, look well. Let the treatment of the subject be bold, and free, and strong. Gesso is not fitted to the carrying out of minute details. When a little experience has been gained, a slightly more advanced exercise can be attempted. Cover a panel of wood with gesso, and rapidly sketch the design. Now model on the background a set pattern in low relief, after the style of old illuminations or figure pictures. Next fill in the design with gesso in higher relief, and let the whole set. The gesso composition will take the colour more easily if it is sized, but this is not always necessary. Silver the background, gild the set pattern, and tint the design, which is in high relief, with emerald or serge blue, relieving it with copper gold in parts. If it is desired to get a bright effect, size and varnish the panel; if not, the gold alone can be sized; this renders it more permanent. As nothing more is required in the way of finishing, it will be understood how easily and quickly gesso work can be executed. Prepared metallic colours of a number of beautiful shades are sold in tins. In using them, pour off some of the liquid, turn out the requisite amount of colour on to the palette, and put the rest of the liquid back into the tin; this keeps the colour in good condition. The white powder and the composition must be well mixed; if too much of the latter is added to the powder a high relief cannot be secured. The brushes and palette are cleaned with turpentine. Excellent effects may be obtained by shading a background from silver to blue, or by graduating the tints from light blue to dark blue, or from salmon to bronze. A background, again, may be entirely gilded, or silvered, or coloured to any desired shade. It is unnecessary to gesso the panel for gilding or silvering unless a decorated background is wanted; in the latter case the decoration is first moulded, or incised, on the gesso ground and the whole is then coated with gold or silver. The design may be silvered, copper gilded, or gilded. The indentations may be accentuated with colour. Again, the design may be tinted with one or more colours relieved or not according to fancy, with gold, silver, or copper gold. It will be seen that greatly varied effects can be produced in gesso decoration. To make a profit on picture frames executed in gesso work, great facility in rapidly producing decorations must be attained. Amateurs are more given to perfecting details than to attending to the general effect, which, after all, is the main point in decorative arts. The outlines should be kept true and sharp, but the modelling of the foliage will not need the amount of care and labour bestowed on it as would be wanted on a figure or a panel. The work can be quickly done either with or without the aid of cotton-wool. Workers of little experience often suppose that high relief is effective. To a certain extent it is, but the purpose of decoration must be borne in mind. There is no true art in subordinating the picture or photo, which should be the centre of interest, to the ornamentation of the frame; therefore the design should be kept in rather low relief, and the colouring should be quiet in tone. The latter is more important if the photo is coloured; for etchings, too, the colouring of the frame should be subdued, but for plain photos a bright frame is often desirable.

Red Facing Bricks.—Red facing bricks should be made from a clay or marl containing sufficient iron to give the colour on burning. To make a red brick from blue clay, mix with it very carefully 5 to 15 per cent. of ochre or red oxide of iron (red hematite) finely powdered.

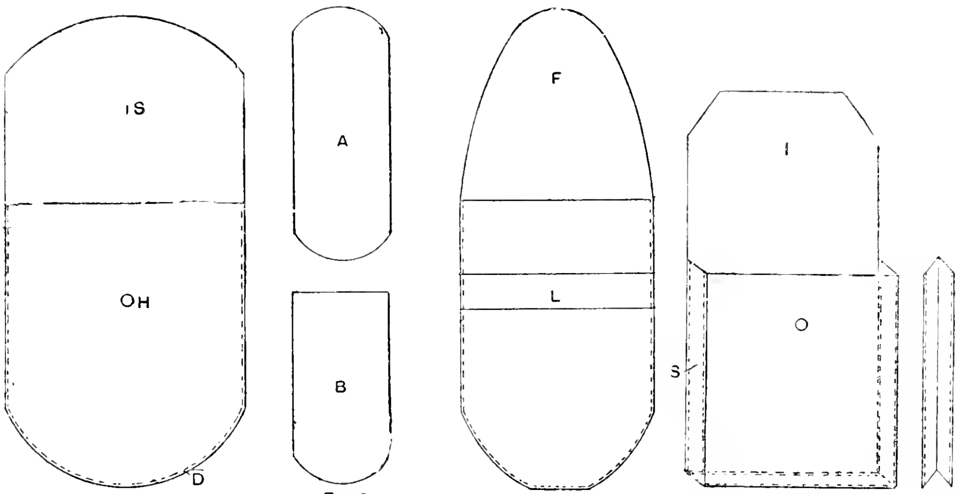


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

How to Make Leather Purses.

Slopes, Batters, and Gradients.—In speaking of the slope of a bank, the expression 1 in 1½ means that the slope is in the proportion of a rise of 1 vertical for a distance of 1½ horizontal; thus, if the bank is 10ft. high with a slope of 1½ to 1, or 1 in 1½, the width at base will be 15ft. For sloping walls the slope is called a batter; thus the steepest bank being, say, ½ to 1, a wall at the same angle would be said to batter 6in. per foot, meaning that the top is set back 6in. for every 1ft. in height. A gradient is a very flat slope such as the longitudinal surface section of a road or railway, where the gradient may be from 1 in 30 in the former case, to 1 in 2,000 in the latter, meaning 1 vertical to 30 or 2,000 horizontal.

Damp-proofing Walls.—Various methods have been recommended at different times for preventing damp showing on the inside of a defective wall, one of the most effective being covering the wall with lead foil before papering. At best, this is only a temporary expedient, the plaster in time disintegrating, and having to be renewed every two or three years. The best method is to deal with it from the outside. A few coats of wash made as thick as cream with neat Portland cement and applied on the outside will do much to keep out the damp.

Hints on Retouching Negatives.—Shadows may be deepened in a photographic negative, and opaque (or light) lines removed by scraping with a sharp knife as shown in the accompanying sketch. Its edge is turned over slightly so as to scrape away a thin layer of film. The negative must be thoroughly dry and should be warmed slightly, or the film may tear. A much better light is necessary for the use of the knife than for pencil work. Scrape only the least possible amount at each stroke, producing a slight grating sound; the effect should not be visible till after a few strokes. For this work remove the ground glass from the desk. Decided white lines are due to working too heavily or using too soft a lead. Avoid touching the eyes—that is, the iris and pupil. View the effect of the work from all angles by turning the negative round. For

Tool for Retouching Negatives.

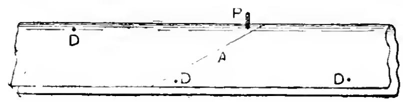
thin lines the point may be used, but for broader spaces use the side of the blade. The easiest plan is to stipple in the part with water colour. Mix crimson lake, ultramarine, and black to match the photograph. Soak some lumps of gum arabic in water and melt by warming. Mix well a few drops with the paint; the surface should then have on drying the same appearance as the surrounding parts. It is well to have a cup of thin gum water at hand to dip the brush in occasionally. Keep the touches as even and close together as possible. Another good plan for deepening the shadows is to rub them down with a leather stump dipped in alcohol. For large patches resort to chemical reduction (hypo and ferricyanide of potash).

Particulars of Ivory.—Ivory differs from bone in its finer structure and greater elasticity, and in the absence of those larger canals which carry blood-vessels through the substance of bone and appear upon it as specks or streaks according as the bone is cut lengthways to or across the grain. On examining the cross section of a tusk cut at a distance from the growing pulp, its middle is seen to be occupied by a darkish spot of different structure; this is the last remains of the pulp roughly calcified. The outer border of the tusks consists of a thick layer of cementum (commonly called "bark"), with which the whole tusk is coated, and the rest is ivory. The different ivories are the mammoth, found in Siberia; African, Indian, Ceylon, and Desert, found in the sands. The best ivory is African. The largest quantity comes from Africa; less than one-fourth comes from India. African ivory is closer in the grain, and has less tendency to become yellow by exposure than Indian ivory. When first cut it is semi-transparent and of a warm colour, and as it dries it becomes much lighter and more opaque. Ivory also shrinks considerably during the drying process, so that it is necessary to season it like wood when such things as box lids are to be made from it. In buying ivory, it is not always possible to judge its quality before the tusk is cut up. The tusk should be smooth and polished and of a deep copper colour, and should not show any large cracks. As about one-half the length of a tusk is hollow, when cutting one up great care must be taken to cut it up to the best advantage. With age ivory turns yellow, and various recipes have been given for restoring its whiteness, but they mainly depend on the removal of the outer surface, and no more satisfactory method is known than exposing it to the light. Ivory may be made flexible by submitting it to the action of phosphoric acid; when washed and dried it becomes hard, and when moistened again resumes its flexibility—but at the sacrifice of many of its properties. Ivory takes dyes well without interfering with the subsequent polish of its surface. Of other ivories, the canine teeth of the hippopotamus furnish an ivory harder and whiter than that of the elephant and less prone to turn yellow. The tusks of the walrus furnish ivory of a dense and rather imperfect consistence. The spirally twisted tusk of the narwhal, the teeth of the sperm whale, the ear-bones of whales, and the molar teeth of the elephant are also made use of as sources of ivory, whose quality, of course, varies greatly.

Particulars of Ammonium Tartrate and Potassium Phosphate.—Ammonium tartrate is made by neutralising a solution of tartaric acid with ammonia and then evaporating to dryness. Potassium phosphate may be obtained by adding carbonate of potash to a solution of acid phosphate of lime (superphosphate) until it ceases to effervesce. The precipitate is filtered off and the liquid evaporated until the salt crystallises out. The apparatus required would be wooden tubs or vats, a large wooden frame with cotton stretched over for filtering, a large shallow pan, and a boiler or fire for evaporating the solution.

Use of Watchmakers' Turns.—In using a pair of watchmakers' turns when putting a new cylinder in a watch, the cylinder must have a brass ferrule affixed to it by shellac. It is rotated by means of a light whalebone bow about 9in. long, strung with a horse-hair. The motion given by a bow is backward and forward, therefore cutting is only done on the forward or down stroke, the graver being held slightly away from contact with the work during the up stroke—that is, the backward motion of the bow.

Affixing Leather to Band-saw Wheel.—The leather should be stretched previous to being secured



Affixing Leather to Band-saw Wheel.

to the wheel. Leather bands are not made endless and sprung on, as are rubber bands. The ends of the leather should be cut aslant, as shown at A, and small holes made in the rim of the wheel to receive wooden pins. Warm the rim of the wheel, and give it a coat of good glue. Place one end of the leather on the wheel, and drive a pin in the hole P; pull the leather tight, and press it firmly on the rim of the wheel as it is passed round. Butt the ends, as at A, and drive the wooden pins, previously dipped in glue, into the holes D. Allow the glue to set hard; then remove all surplus glue, and cut off the pins close to the leather. Now place the wheels on the machine, and set them running. Whilst they are in motion, press on the bands for a minute or two a piece of coarse glasspaper. The wheels will now be ready for work. Well glue the ends of the band where it butts.

Substitutes for Ivory.—Substitutes for ivory are bone, xylonite, and a French celluloid. The two latter productions may be obtained in sheets from $\frac{1}{16}$ in. to 2in. in thickness, and in blocks to order. They are subject to considerable shrinkage, but can be cut, carved, pressed, moulded, and polished, and are highly inflammable. Information on working celluloid is given on p. 98. When bone is intended to take the place of ivory, only the best cuts are used, and a higher finish is given to the manufactured article.

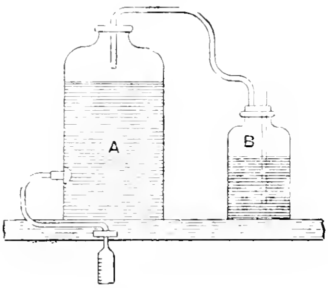
Packing for Plunger of Pump Piston.—A simple and good packing for a piston can be obtained by using three leathers. One, at the centre, is a simple disc, and on each side of it is a cup leather that fits the bore of the pump barrel. One of the cup leathers is placed against the end of the plunger, and the other is kept in place by a thick washer, a set-screw passing through the centre of the leathers and threading into the plunger. The whole is pulled up tight by means of a nut bearing on the face of the washer.

Fixing Water-colours.—To prepare water-colours so that they will not run when washed over a second time, rub the colours up in a solution of gum dammar in alcohol, instead of in water; they should not then run when used for lines. For ordinary washes, there ought to be no difficulty when they are rubbed up in water, if the colour is allowed time to soak into the grain of the paper.

Filling in Joints in Bamboo Work.—Badly made joints in bamboo work can be filled in with a mixture of sawdust and hot glue made to the consistency of thin paste, all surplus filling being cleaned off before it dries. Cracks in bamboo can also be filled with shoemakers' heelball. A lighted taper is applied to the heelball, and sufficient allowed to drop into the flaw. After it has set, rub with a clean cloth until the surface is perfectly level.

Making Cyanide of Gold for Electro-plating.—To make cyanide of gold for electro-plating, dissolve 1 oz. of pure gold in aqua regia (a mixture of hydrochloric and nitric acids), evaporate to dryness, dissolve the residue in 15 pt. of water, and add 5¼ oz. of cyanide of potash. Chloride of gold may be used, but about 1½ oz. would be required. The amount of cyanide of potash may be varied.

Mixing Pyro Developer.—In mixing up pyro solution, some prefer to dissolve the pyro immediately before use, as, owing to its affinity for oxygen, it rapidly decomposes in water. This is, however, a somewhat tedious method of working, and often very inaccurate. As the pyro is extremely soluble, a small quantity of water only need be used, which, if previously rendered acid, allows of considerable storage. If a solution of pyrogallic acid and water be allowed to stand in a measure exposed to the air it will be noticed that, although the top of the solution actually coming in contact with the air rapidly oxidises and turns brown, the remainder is unaltered, proving that if the solution can be kept from the air it will keep considerably longer. An authority has suggested that the pyro bottle be fitted with an oxygen trap in the manner shown in the accompanying sketch. The

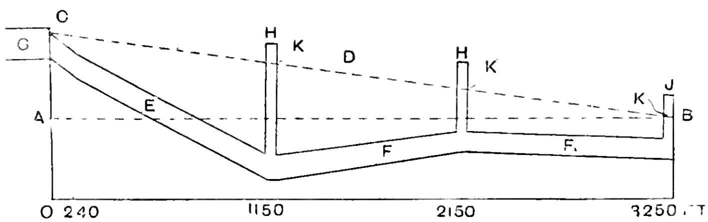


Mixing Pyro Developer.

pyro is kept in A and drawn off from the bottom as shown. The jar B contains a strong solution of pyro and sodium sulphite, both of which readily absorb oxygen. The air that enters the jar B has to pass first through the solution, and a large proportion of oxygen is taken up. Both sulphite of soda and meta-bisulphite of potash are used as preservatives for pyro on account of their affinity for oxygen. The latter is four times as strong as the former, but is more expensive and liable to make the pyro too acid. Another plan is to fill a number of small bottles with a 10 per cent. solution of pyro and seal the tops with paraffin wax.

Recipes for Luminous Paints.—In the manufacture of luminous paints commercial varnish containing lead or manganese must not be used, as it would destroy the luminosity of the paint. A suitable varnish is made by a process patented by Schatte, of Dresden. Three parts of molten Zanzibar or Kauri copal are dissolved in 12 parts of oil of turpentine; the solution is filtered and then mixed with 5 parts of pure linseed oil, which should have been heated and allowed to cool previous to mixing with the solution. It is this varnish that is referred to in all of the following recipes, and in all cases after mixing together the paint ingredients as specified below, they should be run through a paint mill. The latter should not contain iron rolls, as the particles of metal, liable to be detached, would affect the luminous properties of the paint. *Blue:* 42 parts of varnish, 10·2 parts of sulphate of barium, 6·4 parts of ultramarine blue, 5·4 parts of cobalt blue, and 16 parts of luminous calcium sulphide. *Grey:* 45 parts of varnish, 6 parts of barium sulphate, 6 parts of calcium carbonate, 0·5 part of ultramarine blue, and 6·5 parts of grey zinc sulphide. *Green:* 48 parts of varnish, 10 parts of sulphate of barium, 8 parts of green oxide of chromium, and 34 parts of luminous sulphide of calcium. *Orange:* 46 parts of varnish, 17·5 parts of sulphate of barium, 1 part of Indian yellow, 1·5 parts of madder lake, and 38 parts of luminous calcium sulphide. *Red:* 60 parts of varnish, 8 parts of powdered sulphate of barium, 2 parts of madder lake, 6 parts of realgar (red arsenic sulphide), and 30 parts of luminous calcium sulphide. *Violet:* 42 parts of varnish, 10·2 parts of barium sulphate, 2·8 parts of ultramarine violet, 9 parts of cobaltous arsenate, and 36 parts of luminous calcium sulphide. *Yellow:* 48 parts of varnish, 10 parts of barium sulphate, 8 parts of barium chromate, and 34 parts of luminous calcium sulphide. *Yellowish brown:* 48 parts of varnish, 10 parts of barium sulphate, 8 parts of auri pigment, and 34 parts of luminous calcium sulphide. *White:* 40 parts of varnish, 6 parts of barium sulphate, 6 parts of calcium carbonate, 12 parts of white zinc sulphide, and 36 parts of luminous calcium sulphide.

Hydraulic Gradient and Sewage Irrigation.—The hydraulic mean gradient of a sewer or water pipe is the line which would be assumed by the surface of an open stream when the discharge at the bottom was equal to that of the sewer or pipe, the cross section of the stream being assumed to be equal to the section of the pipe outlet. In the example shown in the figure, when the outlet at B is discharging at its fullest capacity, and there is an ample supply of sewage coming in at the other end of the sewer to maintain this discharge, the hydraulic mean gradient will be in the position shown by the dotted line B C. The vertical height between A and C is the head of water required to drive the sewage through the pipe at this particular rate, and measuring down from the hydraulic mean gradient to the pipe in any portion of its length, the vertical heights give the pressure tending to burst the pipe at that point. So long as this full discharge is maintained, the liquid will rise in the manholes to the height of the hydraulic mean gradient, and will consequently overflow at the weirs fixed at that height. Supposing now that the supply of sewage were to diminish, and only a trickle come down the sewer, it is obvious



Hydraulic Gradient and Sewage Irrigation.

that the sewer would gradually fill up to the horizontal line A B, and then as soon as a trifling head of water had accumulated at the end A, the liquid would overflow at B. In this case the hydraulic mean gradient would be very nearly horizontal, and the sewage would not rise in the manholes sufficiently high to overflow at the weirs. For this reason the sluice valve is provided at the manhole at B. By shutting down this sluice to the required extent, the outlet can be made smaller, so that the water backs up in the sewer, and rises to the height of the weirs. The discharge will be very small compared with the discharge in the first case, but the hydraulic mean gradient will be in the same position. Reverting to the simile of the open channel on the line of the hydraulic mean gradient, it will be recognised that with a head equal to the distance between A and C there would be a large discharge if the channel were of a size equal to outlet of the pipe; but if the channel were of a cross section equal only in area to the diminished outlet when the sluice is partly closed, the same head of water will be required to drive a much smaller flow through the channel. With respect to the sluice valve near the top end of the sewer, if its position is at 240 ft. on the horizontal line it can be brought into use, as it will be below the highest position of the hydraulic mean gradient. The letter references not already described are as follow. D, hydraulic mean gradient; E, pipes 30 in. in diameter; F, pipes 24 in. in diameter; G, open channel; H, manhole; J, manhole and sluice valve; and K, weir. It is obvious that the illustration is merely a diagram; it is not drawn to even approximate to any scale.

Extracting Zinc from Tin.—The following have been given as methods of extracting zinc from tin. (*a*) Raise the mixture to the vaporisation point of zinc; this involves great waste of tin. (*b*) Granulate the mixture, and immerse it in a solution of sulphuric acid, when the zinc will be dissolved. (*c*) A method employed to remove zinc from plumbers' solder is to melt the latter and stir in ground sulphur; the sulphur rises to the surface, and brings the zinc with it. This method of introducing sulphur might succeed with tin in place of the solder.

Electro-silvering Tin Teapots.—These are instructions on silvering the inside of a tin teapot. Well scour the inside with powdered Bath brick or Trent sand until quite bright; then well rinse in potash water, and fill, whilst still wet, with a good alkaline coppering solution. Connect the teapot by a copper wire to the negative pole of the plating dynamo, and suspend a strip of copper in the pot by a wire connected to the positive pole, and see that this wire does not touch the vessel. In a few minutes the inside should be coated with a thin film of bright copper; then pour out the coppering solution, and substitute a silver-plating solution, and a strip of silver instead of the copper strip. Deposit silver in the teapot until of the required thickness; then pour out the silver solution, rinse with hot water, scratch with a soft wire brush, and polish lightly.

Rendering Tracing Paper more Transparent.—To render tracing paper more transparent dissolve ¼ oz. of gum mastic in 6 oz. of best turpentine, and apply this to the paper with a brush and hang up to dry. Or take 2 parts of Canada balsam and 3 parts of turpentine and add a few drops of sweet oil; sponge or brush on to the paper while slightly warm, and hang up till dry.

Making and Upholstering Fender Stool.—Fig. 1 shows a portion of an upholstered fender stool. In its construction may be used any thoroughly dry, seasoned wood, preferably mahogany, walnut, oak, or beech. The stool may be 4 ft. 3 in. long by about 6 in. high. The framework should be 2 in. or 2¼ in. deep by 2 in. wide, carefully framed at the corners. If desired, a moulding may be fixed round the bottom edge, as Fig. 2. Strips of webbing are nailed on the top, and over this canvas. On the canvas the stuffing, which should be curled hair, is upholstered. Over this place the covering, which may be tapestry, leather, velvet, cretonne, or any suitable material. This is fastened by strips of leather or gimp to the sides of the stool, being fixed by ornamental brass nails. Fig. 3 gives four patterns for the feet of the stool.

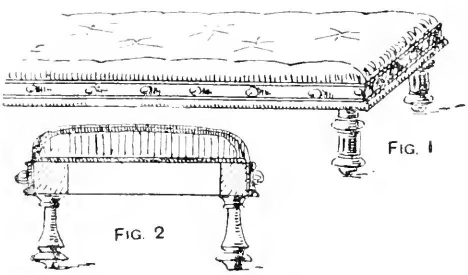


FIG. 1 FIG. 2

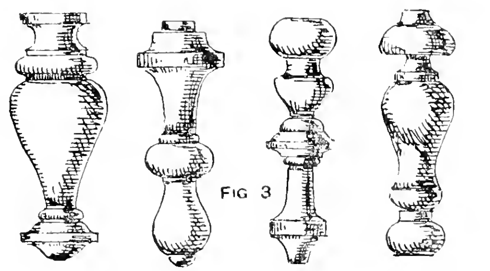


FIG 3

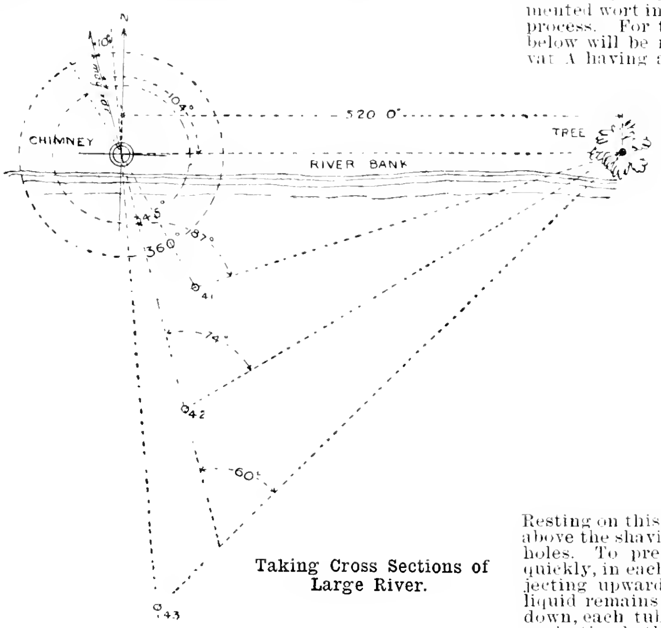
Making and Upholstering Fender Stool.

Restoring Colour of Gold Chain.—To restore the colour of a 9-carat gold chain that has been burnt black and blue, swill it in a warm solution consisting of 1 part of sulphuric acid to 20 parts of water; then rinse in clean warm water. If the colour appears too pale, swill again carefully in a warm solution consisting of 1 part of nitric acid to 10 parts of water; then rinse in clean warm water, dry by rubbing in hot sawdust, and polish with rouge. If the chain is badly burnt, it may be necessary to electro-gild it.

Making Carbons for Electric Lamps and Batteries.—Coke, the material from which the ordinary lighting and battery carbons are made, is usually a by-product of the process of petroleum oil refining, being the solid that remains in the stills after the oils have been evaporated. Coke carbon obtained from other sources can of course be employed for the purpose. The coke is in the form of irregular chunks of black porous material, somewhat lighter than coal-coke, and is ground in a vertical bark mill to what is known as pea-size, and, by means of belt elevators, is taken to large iron storage tanks above the retorts, being drawn from there into small iron cars which run along the top of the retorts, and discharge their contents directly into the calcining ovens. Here the coke is subjected to a high temperature by the burning of coal gas, the ovens being kept closed; all the volatile matter and other impurities are consumed, the residuum being pure carbon. After cooling to a certain degree, the doors are opened and the material is hauled out; it falls into a metal trough in front of the retort, a link belt conveyer in the trough conveying the carbon to an elevator. This raises the material and allows it to fall through flexible chutes, which deliver it in even layers over a floor, where it is left to cool. The carbon, when cool, is passed through grinding mills, either vertical or horizontal; the latter resemble the burr-stone mills employed in grinding grain. The powdered carbon is separated into different grades in a set of bolting machines, the coarser grades being afterwards re-ground. Following the bolting process, the material is delivered to a number of steam-heated revolving iron barrels or boxes, in which the carbon powder is incorporated with the binding material; this is prepared by a special process and is ground and bolted in much the same manner as is the carbon. Being suitably mixed, the material is got ready for the moulding or forcing process. In the shaping of the arc-lamp carbons and battery plates, one of two processes is followed; one is known as the moulding process, and the other as the forcing. In the former the material is carefully weighed, and then placed in the moulds, which consist of grooved plates of steel containing from twelve to eighteen forms, depending upon the diameter of the pencils to be moulded. The material is carefully packed and adjusted, and then smoothed off with a straightedge, and the second or upper part of the mould is then pressed upon the lower one. The filled moulds are placed on endless chains, which convey them in the direction of the hydraulic presses. Before reaching the latter they are led over a slow-running conveyer which passes through a gas-heated furnace; on emerging from this the moulds are placed upon the head of the vertical plungers of the presses. After having been subjected to great pressure, they are released and the formed pencils, which are held together by a thin web of material, are removed and placed on a corrugated pan. The moulds must be oiled before refilling. The pencils are held straight on the corrugated pan until cool, when they are broken apart by hand and fed one at a time into the strippers, which automatically draw them through very rapidly and shave off the portions of the web that may adhere to the sides of the pencils. The scrap is returned to the mills to be ground and treated again. Before describing the baking process through which the pencils next pass, the forcing method of forming the pencils must be touched upon. The mixture of powdered carbon and binding material is hydraulically pressed into compact cylinders, and these are fed, one at a time, into the Jumbo presses; in these large cylinders are plungers, which force the material through dies, upon the size of which must of course depend the size of the resultant pencils. The material is forced out into grooved trays and broken off into lengths of about 4 ft. When cool, these are passed through a machine and further cut to the desired lengths. Pencils produced either by the moulding or the forcing method are baked in the same manner, being carefully piled in the firebrick furnaces in regular rows; a small thickness of carbonising material is placed between each layer of pencils. When the furnace is full it is covered with a kind of clay that vitrifies in the baking process and, covering the bed with a scale, prevents the gas employed as fuel coming in contact with the carbon pencils. The baking lasts for eight or ten days, at the end of which time the top of the oven is removed and the pencils, when cool, lifted out with implements resembling hay-forks. The pencils for the electric arc lamps are then sorted and tested for straightness, being allowed to roll down an inclined steel plate. Any crookedness is made apparent by light rays between the pencils and the steel plate. After being sorted into about three qualities, the pencils formed by the forcing process are pointed in machines. Cored carbons are filled with the special preparations by machinery, the material in the form of a thick metallic paint being forced into the cavity of the carbon by hydraulic pressure.

Composition for Blackening Face.—To make a composition as used by minstrel troupes for blackening the face and hands, place some good corks, champagne for preference, on an iron plate over a bright fire. When they are thoroughly burnt, remove them from the fire, crumble them up, mix into a paste with a little water, or beer, or glycerine, and place in a gallipot. To use, take a little of the black in the palm of the hand, and add a drop of the liquid previously employed; rub up, and apply to the face. The black can easily be removed with warm water and soap.

Taking Cross Sections of Large River.—It is supposed that a method is required of taking cross sections of a tidal river. Soundings must be taken from a boat, with a lead plummet having a round plate above to rest on the mud. The position of each section will be marked in turn by two station poles on the same bank, so that the true line can be sighted from the boat, but the position of each sounding must be obtained by observing the bearings to, or angles between, certain fixed and permanent points, as a chimney stack, steeple, tree, house, etc. Two observations at each point will generally be sufficient. By noting



Taking Cross Sections of Large River.

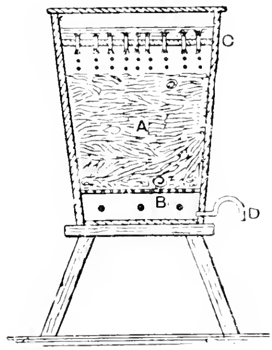
the time of sounding and comparing with the time of high and low water, the proportion between the total rise and fall and that which had then occurred will be found. The actual height of each tide must be recorded at a tide gauge on shore as long as the survey lasts. The following is a sample of the entries:—

No. of Section, 5. High water, 2 p.m.

No. of Sounding.	*Time.*	*Depth in feet.*	*Location.*	
41	2.15	$6\frac{1}{2}$	Chimney 345.	Tree 87
42	2.25	9	„ 360.	„ 74
43	2.10	$11\frac{1}{4}$	„ 10.	„ 60

Chimney to tree 520 ft., bearing 101°, that is east of magnetic north taken with prismatic compass (mag. var. N. 16 W.). The accompanying figure shows the plotting of these three soundings with the construction lines left in. After the soundings are all corrected they can be entered on the plan, and then sections made in any required direction. When the angle has been taken between the fixed stations instead of their bearings, the method of plotting is different and also more complex. In the present method, if the bearing from the sounding to chimney is 345°, that is north 15° west of the magnetic meridian, or north 15 + 16 = 31° west of the true meridian, the bearing or direction from the chimney to the sounding will be the reverse of this, or south 31° east.

Making Vinegar.—To make vinegar proceed as follows. To 3 bushels of malt add 20 gal. of water at a temperature of about 170° F.; after stirring well for about half an hour, strain off the clear liquid and pour on another 20 gal. of water, followed by about 10 gal., when the malt will be exhausted. The liquids are mixed and cooled quickly to 70° F.; then the yeast is stirred in and the vat covered. After fermenting for from twenty-four to thirty-six hours, the wort must be carefully strained and run into barrels (three-fourths full) set on their sides in a cool, airy place. Holes about 2 in. diameter are bored in both ends of the barrels to allow a free circulation of air. The acetification will require several months, and the vinegar must be filtered before being used. There is also another method of converting the fermented wort into vinegar, known as the "quick" vinegar process. For this an apparatus similar to the sketch below will be required. It consists of a large wooden vat A having a wooden partition B bored with holes.



Apparatus for Making Vinegar.

Resting on this partition is a pile of beech shavings, and above the shavings is another partition C also bored with holes. To prevent the vinegar passing through too quickly, in each hole is fitted a piece of glass tube projecting upwards an inch or two, so that this level of liquid remains on the partitions. To conduct the liquid down, each tube has a piece of loose cotton lampwick projecting both above and below, and through this the liquid is drawn by capillary attraction. The tube D is for drawing off the liquid as the bottom of the vat fills with vinegar. Near the bottom six or eight holes are bored to allow air to enter. Boiling water is first poured through the vat until the liquid comes away quite colourless. A little hot vinegar is then run in, the apparatus is allowed to stand a few days, then fermented wort is run slowly through and put back a few times until it begins to smell of vinegar; after a time the vinegar plant or ferment will grow vigorously on the shavings, and good vinegar will be obtained by the one operation only.

Methods of Testing Drains.—To tell whether a drain is properly or improperly laid, exposing it only at two points, the following tests may be employed. (*a*) Put a measured quantity of water in at the top end and see if the same quantity escapes at the lower end. (*b*) Allow water to flow through, and then look through the drain and note if all the water has passed away or whether some is retained in bagged parts. At the same time note if the drain is "like a gun-barrel" or crooked. (*c*) Float apples, small potatoes, or something similar, through the drains to test if there are any obstructions that would arrest floating matters. (*d*) Float a cork with attached cord through the drains, and by such aid drag a drain-bobbin through. (*e*) For fall, place levelling staffs on the inverts at each end and use a sighting level on the surface, or a straightedge and pocket level can be used; or (*f*) bends and upright pipes can be temporarily connected to the ends, the whole filled with water, and the depth at each end measured. This would also test the soundness of the drain.

Hydrometer for Soap-making Lye.—The strength of a soap-making lye is often given in degrees Tw.; this refers to the density of the lye as indicated by a Twaddel hydrometer, the instrument generally used for the purpose in soap-making. The hydrometer is immersed in the lye, whose density can then be read off from the scale at the top of the instrument. Twaddel hydrometer degrees are converted into specific gravities by multiplying by ·005 and adding 1. Thus the specific gravity of, say, 65° Tw., is: $(65 \times \cdot005) + 1 = 1{\cdot}325$.

Oval Top Wooden Box.—The accompanying drawings show a method of constructing a strong oval top wooden box. The sides, ends, and bottom should be of wood about ⅞ in. thick, jointed together as at Figs. 1, 4, and 5. The top of the lid may be formed of two ⅜-in. boards bent and glued together and nailed to the end pieces (see Fig. 2); or strips ⅞ in. by about 2¼ in. wide, jointed and glued together, may be used (see Fig. 3). The principal dimensions are given in the illustrations. Two or three coats of paint will be more serviceable than a covering. In the illustrations, Fig. 1 shows a front elevation; Fig. 2, an end elevation; Fig. 3, an alternate method of forming the lid; Fig. 4, a general view of the box; and Fig. 5, the method of joining the side to the front.

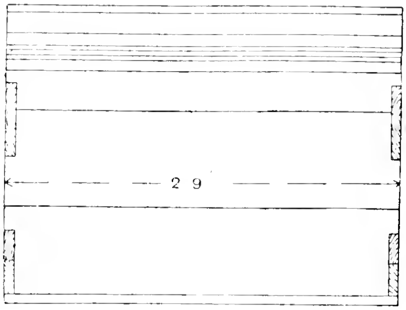


FIG 1

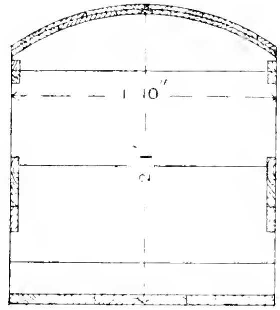


FIG 2

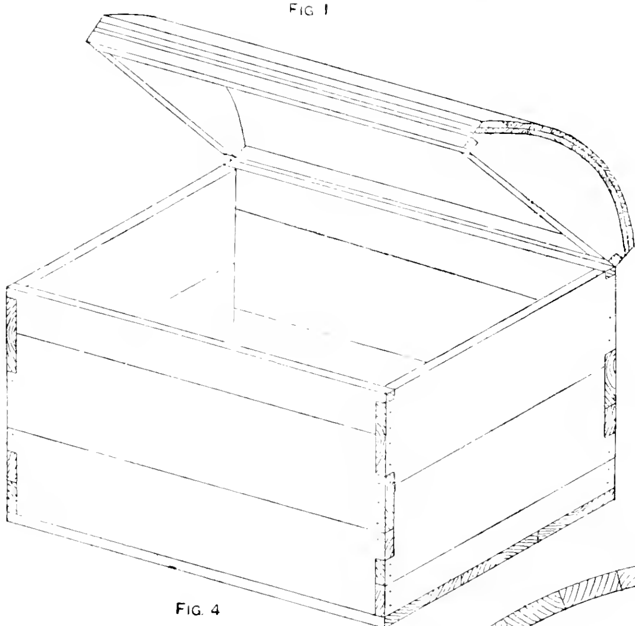


FIG. 4

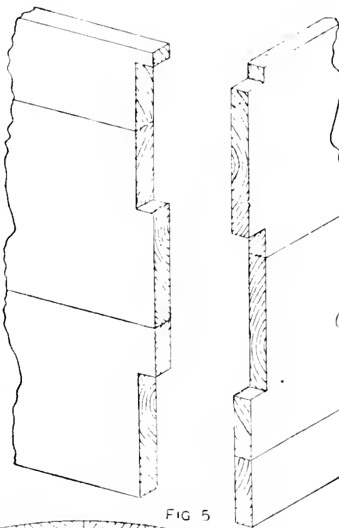
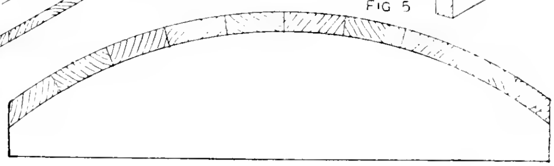


FIG 5



Oval Top Wooden Box.

FIG 3

Recipes for Ink Powders.—Recipes for ink powders are as follow. (1) Add 1 qt. of water to a mixture of 4 oz. of powdered galls, 1 oz. of powdered sulphate of iron, 1 oz. of powdered gum arabic, ½ oz. of powdered white sugar, and 1 dr. of powdered cloves: macerate for an hour or two. (2) Powder and mix together 3 lb. of Aleppo galls, 1 lb. of copperas, ½ lb. of gum arabic, and ¼ lb. of white sugar. For use, dissolve 2 oz. of the powder in 1 pt. of boiling water. (3) Pulverise and mix thoroughly 50 parts of logwood extract and 1 part of bichromate of potash. Add 6½ parts of indigo blue. (4) Pulverise and mix together 16 oz. of nutgalls, 7 oz. of copperas, and 7 oz. of gum arabic. Add two or three powdered cloves to each pound of powder. (5) A simple method of preparing ink powder is to reduce soluble nigrosin to an impalpable powder by grinding. (6) Ink paper, which serves the same purpose as the powder, is made by saturating sheets of paper with aniline black, and then pressing them into a compact form. For use, a little piece of the paper is torn off, and steeped in a small quantity of water.

Cutting Fur Skin.—A large fur that is to be reduced to half its original size may be cut in the following manner. First prepare the pattern to which the skin is to be cut. Place the skin, fur side down, upon the table, arrange the pattern on the skin, and mark out with pencil, chalk, or crayon. Then cut with a sharp knife (scissors must not be used, as they will spoil the fur), being careful that the knife cuts only through the skin and not the underlying fur. Keep all the pieces for corners or places which the pattern does not quite cover.

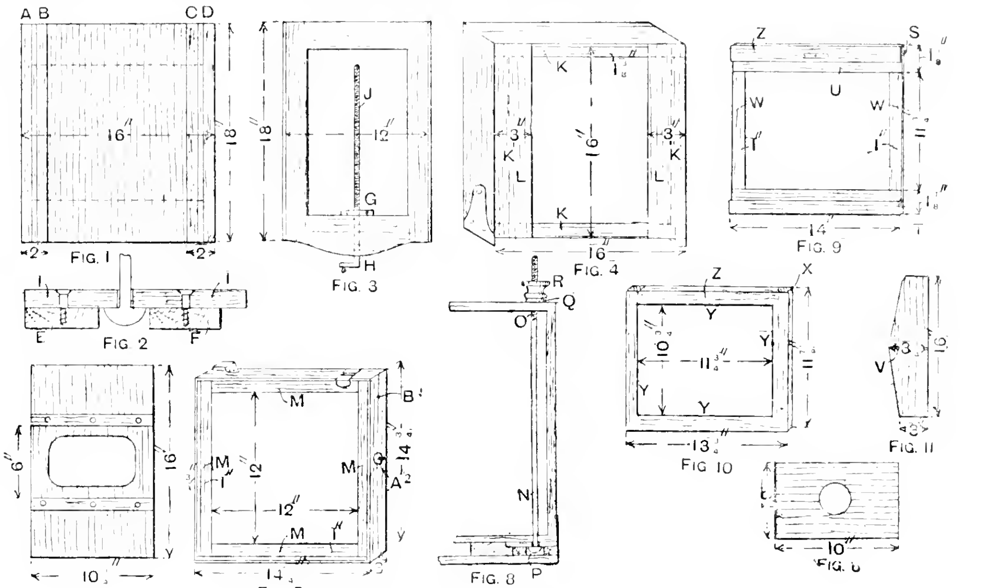
The Terms Man-power and Horse-power.—A man can do from one-fifth to one-ninth the work of an average horse, the proportion depending on the nature of the work; one mechanical horse-power (33,000 ft.-lb. of work per minute) equals the power of about four and a half horses. There is no exact definition of the term man-power.

How to Make a Studio Camera.—A studio camera to take 12-in. by 10-in. plates may be made of ⅝-in. mahogany. First construct the baseboard (Fig. 1) of the size shown in the illustration, by tongueing together. Then make two strips E and F (Fig. 2) 16 in. by ¾ in. by $\frac{7}{16}$ in., and glue and screw these in the spaces A and B (Fig. 1). They will then be ⅝ in. apart, and extend 2 in. from the edges, and stand $\frac{3}{16}$ in. A strip I 2¼ in. by 16 in. is next strongly attached, as in Fig. 2, with a ¼-in. slot for a clamping rod running from about 2 in. or 3 in. from each end. A similar slotted rail is then made to come over C and D (Fig. 1). Next form the extension frame (Fig. 3) to run freely in the grooves of the baseboard rails. Fit the focussing screw J (which may be purchased ready prepared for about 1s.) by screwing down the bolt G to the baseboard, and the nut to the end of the extension frame at H. Construct the sliding frame (Fig. 4) by dovetailing four pieces

The focussing screen frame is formed as in Fig. 10. The tongue X engages with the groove U (Fig. 9), and the $\frac{3}{16}$-in. rebate Y is for the focussing ground glass which is held in by narrow strips of brass across the corners. Attach the screen frame to the reversing back by double hinges at Z Z (Figs. 9 and 10).

Rusty Nickel-plated Surfaces. — All electro deposits of metal are slightly porous, and so when a thin deposit of nickel on steel or iron is exposed to moisture the tiny drops penetrate these pores to the metal beneath and cause rust. A thicker deposit offers a better protection, or better still is a coat of copper deposited on the parts and well burnished previous to being coated with nickel.

Needles Breaking in Sewing Machine.—The needles in a Singer or other sewing machine break either because the needle-bar is bent, causing the needle to strike on the inside edge of the hole in the needle-plate; or the shuttle, or shuttle race, or both, may be worn, thus allowing the shuttle to fall forward sufficiently to get on the wrong side of the needle—that is to say, the point of the shuttle passes on the outside of the needle instead of the inside. If the bar is bent, straighten it by striking



How to Make a Studio Camera.

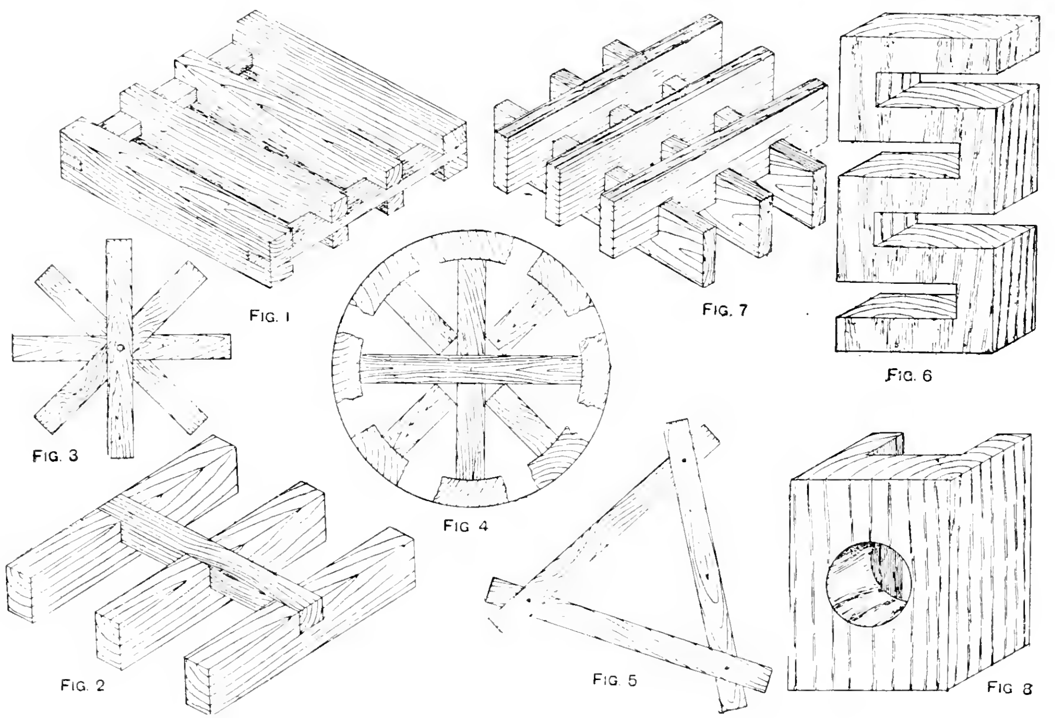
each 16 in. by 3 in. Inside this fit a frame K 1⅛ in. wide, flush with the front edges, and screw across two grooved pieces L for the rising front, 3 in. by 16 in. The rising front board may next be got out, with the two rebated rails for the sliding front; this is sufficiently explained by Fig. 5. The sliding front or lens board is shown in Fig. 6. Now make the back frame (Fig. 7), giving about ⅜ in. slope to the top and bottom to allow of swing. These four pieces, 14¾ in. by 3 in., are dovetailed together. Then sink the nuts for the thumbscrews B² and the pivots A². Inside the framework fit carefully a framework M exactly ⅝ in. from the back edge, and 1 in. wide; cover it with velvet on the near side. It is an advantage to bevel the frame towards the centre to allow of central expansion of bellows when closed. Proceed to fit the clamping rods N (Fig. 8). These consist of a long screw and nut, but the thread O need only extend about 1 in. P is a circular plate to grip the side rail, Q a washer, and R the thumbscrew or clamping nut. The bellows may be obtained ready made from dealers in photographic materials. Glue the front of the bellows to the framework L (Fig. 4) and the back to the frame M (Fig. 7), and place under pressure till thoroughly dry. The fixed frame (Fig. 11, side view) is prepared 16 in. by 3¼ in. The back frame is fitted with the pivots to the fixed frame at V, and the whole is then made up and screwed firmly to the back of the extension frame. Now make the reversing back (Fig. 9) by first joining up a frame of four pieces, and across them glue and screw two strips S and T 1⅛ in. by 11 in., with ¼ in. groove at U. A further strip may be fitted across between the two at W (not shown) to form a stop for the slide. This must all be done in $\frac{7}{16}$-in. stuff to make the frame exactly ⅝ in. thick when finished

at its highest point with a light hammer while in the machine. If when this is done the needle dips down in the centre of the hole in the needle-plate correctly, and the shuttle can be moved with the fingers enough to strike the needle instead of passing without touching, either a new shuttle must be procured or enough of the point of the old shuttle, if not badly worn, must be rubbed off on a piece of emery-cloth to allow it to clear the needle.

Gilding Figured Oak.—In gilding figured oak with gold leaf, having planed up the surface of the wood, well glasspaper it if a smooth finish is desired; for a rough finish, glasspapering is not necessary. Evenly apply with a camel-hair brush two or three coats of spirit varnish or brush polish to prevent suction. When the varnish is dry, the gold size should be evenly applied. If required to dry very quickly, say in half an hour or less, japanners' gold size may be used. But the better plan is to coat with oil gold size one day and apply the gold leaf the next. The oil gold size can be bought ready prepared. Or the two kinds of size may be mixed in varying proportions according to the time allowed for it to acquire its proper tack. The use of gold leaf on transfer paper is advised, as it is easier to handle and avoids waste. When the gold size has acquired its proper tack it should have a nearly dry pulling feeling on pressing the finger knuckle against it. In applying the gold leaf, press well down with the ball of the thumb or soft, clean, chamois leather. If the tack is right the paper will lift, leaving the gold with a bright surface. Take up each leaf of paper as the gold is pressed home, and allow the next to overlap at least ¼ in.

Black Inlay for Mandolines. Common glue strongly impregnated with lampblack or vegetable black, or even fine ebony sawdust, is sometimes used for inlaying cheap mandolines. Black sealing-wax is also effective. A harder substance closely resembling sealing-wax, known as beaumontage, is made by melting together shellac 3 oz., resin 1 oz., and beeswax ½ oz., with sufficient lampblack as required. Roll into sticks. Both substances are run in by pressing against a hot iron. Another useful filling is made by melting together resin 3 parts and wax 1 part with sufficient black to colour. It may be kept in melted condition by gentle heat, and can be pressed where required with chips of wood cut wedge shape.

Making Firelighters.—Figs. 1 to 8 show a few simple forms of firelighters. If firelighters are to be made for the purpose of sale, care must be taken not to infringe existing patents. The pattern shown by Fig. 2 is the subject of a patent. The pieces in Fig. 3 are joined by a wooden peg. In Fig. 4 a string or wire binding is employed to keep the various pieces in position. Fig. 5 consists of three or more sets of sticks, as shown, the interior being filled up with shavings or other combustible material, and the whole bound or nailed at the corners. In Fig. 8, in a block originally solid, a hole is pierced through the top, and a wide groove made along the bottom. These recesses are filled with tow, shavings, etc. Most firelighters are dipped, partially or wholly, into a hot solution of resin and turpentine. Crude paraffin and crystal oil, carbolic acid and resin oil, and even tar and pitch, are also used; but generally preference is given to some form of resin.



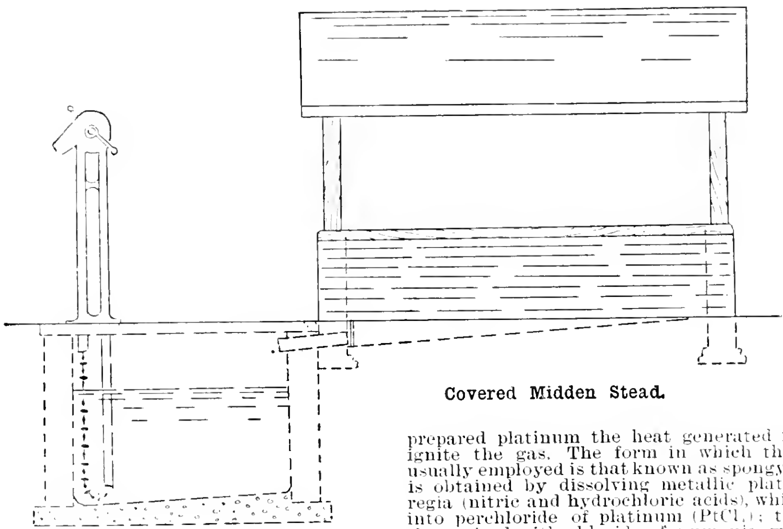
Firelighters.

The Use of French-polish Revivers.—The secret of success in the use of French-polish revivers lies in the ability to clear off any trace of oil that may be used, and in making the polished surface free from grease and dirt. Some revivers combine the two qualities, and act as a cleansing and restoring agent. Should the article be very dirty, it should be first cleansed with warm soda water—half a small teacupful of common washing soda dissolved in 1 gal. of water will answer. The same procedure may also be required in the case of goods on which creams and pastes with a wax basis have been used. Good results cannot be obtained from revivers containing oil, vinegar, or spirit if used on a surface previously cleansed with wax. Furniture creams or pastes, or even the old-fashioned beeswax and turpentine, will, in skilful hands, give good results. It is supposed that an article, the polish of which has gone dull, requires freshening up. Use a mixture composed of lime water, raw linseed oil, and turps in equal quantities. The two former are first well shaken till thoroughly incorporated, and the mixture is then thinned out with turpentine. It is applied rather liberally to the article by means of wadding; rub well to clean away any dirt or sweat, and afterwards wipe off with a piece of rag. Then take another piece of rag, fold it up firmly till it presents a face free from creases, sprinkle this with methylated spirit, and press well in till it presents a fairly moist (not wet) surface. With this rag give the article a smart polishing; apply lightly at first, and exert a little pressure as the spirit evaporates. The second pad, containing spirit only, is for finishing the article; take care to clear away any trace of oil without disturbing or breaking up the lac surface, to which continued friction has imparted a polish. In the case of goods on which it is impracticable to use soda water for first cleansing, it will generally suffice to wipe over with benzoline. This is sometimes used at the finishing stage, with the object of killing any grease; instead of this may be used a reviver made of vinegar, oil, and spirit, to which is added a very little butter of antimony as a grease killer. Failure may result from the first attempt, but the fault may be in the mode of application, or in the fact that the original polish has so sunk into the wood, or perished, that there is really no good lac surface left which can be revived.

Recipes for Stoving Enamels.—The home manufacture of stoving enamel to be applied to metal is not advised. The utensils employed must be free from all dirt, and the ingredients must not contain traces of impurities, or a good-surfaced enamel will not be produced. For a dead white enamel, melt together 1 part of calcine (2 parts of tin and 1 of lead calcined together), 2 parts of fine crystal or transparent glass frit, and a very small quantity of manganese. Pour the fused mass into clean water, dry, reduce to powder, and again fuse, repeating these operations three or four times, taking care to prevent the enamel being contaminated by smoke, dirt, or oxide of iron. A superior white enamel is made by treating 1 part of washed diaphoretic antimony and 3 parts of fine glass perfectly free from lead as before. For a black enamel, mix together 12 parts of calcined iron (protoxide) and 1 part of oxide of cobalt. This mixture is fused with an equal amount of white flux or enamel, made as in the first recipe above.

Staining Poplar to Walnut Colour.—Below is explained how to stain poplar a walnut colour In a jar place one pennyworth of vandyke brown and two pieces of common washing soda the size of large walnuts. Pour in gradually, stirring the while, 1 pt. of boiling soft water. Strain through muslin or coarse flannel to ensure thorough mixing. Apply the solution whilst still hot with a brush, working the way of the grain; rub well in, and wipe off the surplus with rag. Several coats may be given till a good depth of tone is gained. When quite dry, smooth with fine worn glass-paper, then wipe over with raw linseed oil. The work is then ready for polishing. If the article is small, grain fillers may be dispensed with. On close-grained woods it will generally suffice to apply one or more coats of spirit varnish as polishing proceeds.

Constructing a Covered Midden Stead.—The accompanying illustration shows a midden stead 10 ft. long and 7 ft. wide, with 9-in. brick walls, 2 ft. 6 in. high round three sides. The end is left open, so that a cart can be backed in, and the roof is kept high enough for the same purpose. The floor should be covered with flags laid with a fall, as shown, and in the end wall a perforated grating allows the liquid to run through a pipe into the pit. The pit is 5 ft. deep, 6 ft. long, and 4 ft. wide. It may be covered over with 4-in. flagstones. The sides are of 9-in. brickwork, cement rendered, and the bottom is of cement concrete laid with a fall to one corner, so as to make a sump for a chain-pump, which should be fixed high enough to pump the liquid into a tank cart for carrying to a distance.



Covered Midden Stead.

Painting and Varnishing a Dog-cart.—The body of a dog-cart, to be painted blue-black, should be well faced down with pumice-stone and water (if cracked, rub down to the filling-up coats) and the under parts, to be painted red, cut well down with No. 2 sand-paper. The red parts should have a coat of flesh colour, mixed with driers, linseed oil, and turps, a small portion of purple-brown or rose-pink being added to give it tone. The body should have a coat of dark lead colour, made as described above, but adding lampblack instead of the rose-pink. Let it stand for two days, then lightly sandpaper off and stop up any small places. If the body is to be blue, give it a coat of Prussian blue, and afterwards two coats of ultramarine, the first and second coats being so mixed that they will dry rather sharp, the last coat being glaze colour. This is made by adding about one-third varnish to some of the colour already mixed. If the body is to be black, apply a coat of dead black, to dry in about four hours, followed by a coat of japan. Let this stand for a day, then flat down with pumice dust and water, thoroughly wash off every particle of dust, and give another coat. The under-parts having been papered down and stopped up, give them two or three coats of carmine or vermilion, bound with gold size and carriage varnish and thinned with turps, and made to dry as described for the blue. If the wheels, etc., are to be lined out, first flat them to give an even surface and prepare them for varnishing. If two coats of varnish are to be given, for the carriage use hard drying carriage, and for the body under coating body varnish, putting on a medium coat only. After standing for three or four days it is ready for flatting, previous to the last coat of varnish being put on. Be careful not to flat it more than is necessary to remove any small nibs, etc., as the more it is flatted off the more absorbent the under coat becomes, in a measure taking up the gloss of the finishing coat; wash off thoroughly, and give a good full coat, being sure not to get runs or fulness in any corners. Use finishing body varnish for the body and pale carriage varnish for the underworks. Let the cart stand at least two weeks before using it, sponging it in the meantime with plenty of water so as to harden the varnish.

Action of Self-lighting Incandescent Burners.—The active material in most of the self-lighting incandescent burners is the metal platinum in some form or other, and the reason for its employment depends on the fact that it is capable of condensing either on its surface or in its pores a large amount of oxygen, the latter being derived from the air; the result of this is that when a gas such as hydrogen is brought in contact with the metal the two gases unite and in time chemical action ensues. Now coal gas contains, roughly speaking, about 50 per cent. of hydrogen by volume, so in allowing a stream of coal gas to impinge on a pellet of specially prepared platinum the heat generated is sufficient to ignite the gas. The form in which the platinum is usually employed is that known as spongy platinum, and is obtained by dissolving metallic platinum in aqua regia (nitric and hydrochloric acids), which converts it into perchloride of platinum ($PtCl_4$); the solution is then mixed with chloride of ammonia, which combines with the perchloride of platinum to form a yellow insoluble salt (ammonio-chloride of platinum). This precipitate is collected on a filter, washed, and then heated very gently in a stream of coal gas as long as any fumes of hydrochloric acid are evolved. The spongy platinum thus obtained can then be used in the form of pellets, either alone or mixed with other substances.

Softening Snake Skins.—To soften snake skins soak them in water for a night; they should then be soft enough to unroll. Soaking should be carried far enough to enable the skins to be opened without force, but must not be prolonged. By using warm water, about an hour's soaking may suffice.

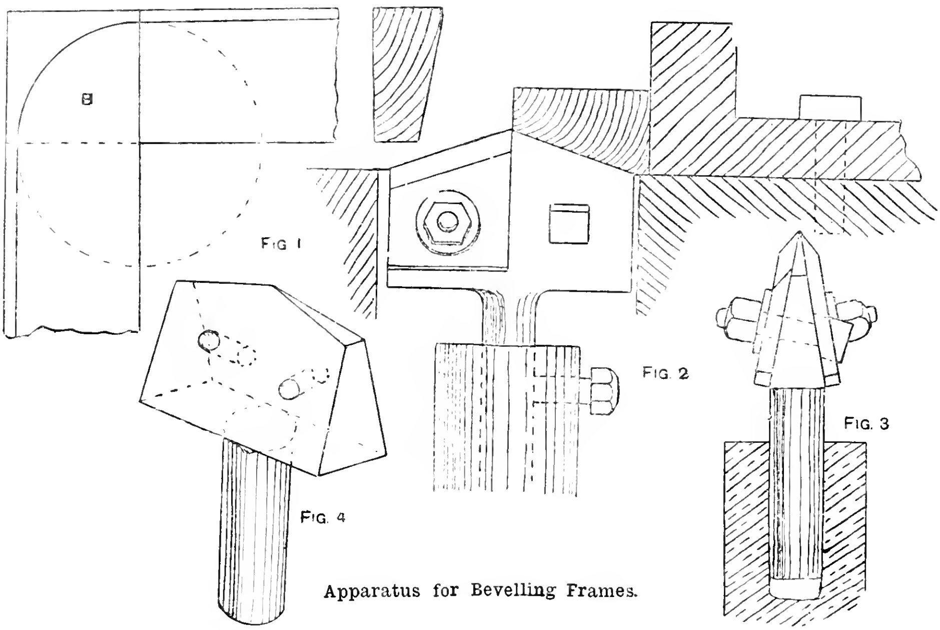
Cleaning Rust from Iron.—In cleaning iron that has gone very rusty, coat it with paraffin and then scour while wet with coarse sand. A wire scratch-brush, if at hand, will help to remove the rust more readily. When all the rust is off, wash in strong soda-water and silver sand. If the iron is very rusty go over it with an old file before putting on the paraffin.

Renovating Leather-covered Furniture.—In renovating faded leather-covered furniture that is slightly worn in parts, first wash the surface of the leather with warm water in which a little washing soda has been dissolved; this will remove grease, etc. Now dissolve ½ oz. of Bismarck brown in 1 pt. of methylated spirit and add ½ gill of French polish. Make up a cotton-wool rubber, soak in the solution, and lightly rub the leather all over; if the colour is not deep enough, go over the surface again. Now take 1 pt. of furniture cream and ½ pt. of linseed oil, slightly warm them separately, then mix well together. Put some of the mixture on a sponge or soft woollen rag, and apply to the leather; finally, polish off with a soft dry cloth.

Making Ammonia.—Ammonia may be made by heating an intimate mixture of sal-ammoniac and slaked lime and passing the gas evolved into water until the latter is saturated, but the method would be very expensive. Ammonia is now made in large quantities by distilling gas-liquor, liquor from coke ovens, or washing waters used in scrubbing the gas from blast furnaces, with lime; ammonia can be bought so cheaply that it does not pay to make a small quantity.

White Paint for Plant Labels.—To make a white paint as used by gardeners for plant labels, grind equal weights of zinc oxide and barytes with the smallest possible quantity of pale gold size and thin with turpentine. A cheaper method of painting the labels is to coat them first with milk of lime (*i.e.* thin slaked lime), and then, when dry, with silicate of soda diluted with four times its bulk of water. Finish with fine sandpaper.

Apparatus for Bevelling Frames.—A vertical spindle moulding machine, with a cutter block similar to that shown by the sketches below, is the simplest thing to use for bevelling the frames, and for cutting out the curved part B (Fig. 1). If a spindle machine is not available and large quantities of frames are to be made, a strong lathe-head could be fixed in a vertical position to a strongly framed wooden table, and a cutter block and two irons fitted. The diameter of the block, with the irons, would have to be twice the breadth of the splay, as indicated by the dotted circle at Fig. 1. Fig. 2 is a front view of the block and irons, Fig. 3 an end view of the same, and Fig. 4 is a conventional view of the block.



Apparatus for Bevelling Frames.

Preserving Bait for Fishing.—The only way to keep the true colour of roach that are to be used as bait for jack fishing is to preserve them alive. Make a wooden box 2 ft. 6 in. long by 1 ft. 4 in. wide by about 9 in. deep. This will hold from twenty to thirty fish. The joints of the box should be put together with thick white lead. The water should be changed about once a fortnight, or oftener if the full number of fish is kept. The tank should be looked over daily and dead fish or ice removed at once. Dead fish may be preserved as follows. Wipe them dry and drop them into a wide-mouthed bottle containing glycerine or spirit of wine. Cork up tightly and cover the cork with melted wax.

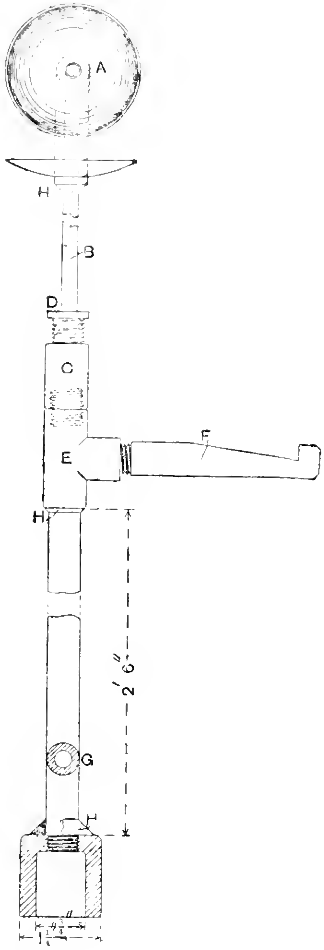
Making Carbon Tissue and Supports.—The following formula for stock jelly for carbon printing can be highly recommended. Nelson's opaque gelatine 4 oz., Coignet's gold label gelatine 1 oz., loaf sugar $1\frac{1}{2}$ oz., water 1 pt. Heinrich's emulsion gelatine may be substituted for Coignet's if the latter cannot be procured. These are harder than Nelson's opaque. Gelatine that has been artificially hardened with alum must not be used. To the above is added for sensitising as required potassium bichromate solution in the proportion of 12 drops per ounce. This solution is made by dissolving $\frac{1}{2}$ oz. of potassium bichromate in 5 oz. of water, and adding about $\frac{1}{2}$ dr. of liquor ammonia. Allow the gelatine to soak for a time, and dissolve by heat in part of the water. Dissolve the sugar in the remainder, and add gently whilst stirring. Various colours may be used, but Chinese ink is a favourite with workers in a small way. Allow this to soak till it is in a thin paste, then add to the jelly until a piece of paper floated upon it and drained appears quite opaque when held against an ordinary gas jet. Stir thoroughly when adding the pigment, and put in only a little at a time. Any pigment may be used which is in a fine state of division.

Setting Up a Surveyor's Level.—In setting a surveyor's three-set screw level first see that the parallel plates are about parallel, and the screws just up to their work; set the legs open a convenient distance, and stand between two of them, with the left hand grasping the tripod head. Place the telescope across the direction of the leg at the right hand, and move the leg backward or forward to bring main bubble central. Then place the telescope in line with this leg, and move it in or out to bring the bubble again central. This is the leg adjustment common to all forms of level and theodolite, and should never be omitted. The fine adjustment for a three-screw level will then be as follows. Place the telescope parallel with two adjacent screws and bring the bubble central, by turning them "thumbs in" or "thumbs out," as the case may be. Then move the telescope round so that the object glass is central between these two screws, and the eyepiece over the third one, and adjust the third screw to bring the bubble central. The bubble ought now to remain in the centre of its run for any position of the telescope. By means of a cross level on the end the leg may be set approximately true for both directions in one operation, but it is more useful on the four-screw instrument.

Ethereal Solution of Gold.—An ethereal solution of gold is made thus: Dissolve 1 dwt. of pure gold in 1 fluid oz. of warm aqua regia (3 parts hydrochloric acid, 1 part nitric acid, and 1 part water), evaporate the liquid until it appears like red syrup, then make up to $\frac{1}{2}$ pt. with hot distilled water. Pour this into a pint glass-stoppered bottle, add a fluid ounce of sulphuric ether, and well shake. The ether will take up the gold from the acid, and float above it when at rest. This solution is applied with a camel-hair pencil, and on bright iron and steel it forms a fairly adherent coat, which may be lightly burnished. It will also deposit its gold on other metals as the ether evaporates; but it must always be regarded as a kind of gold paint. As it is highly volatile, and is affected by light, it should be kept in a closely stoppered bottle in a dark place when not in use.

Glaze for Finishing Furniture. To make a glaze for finishing furniture dissolve 8 oz. of best gum benzoin in 1 pt. of methylated spirit; keep it warm and frequently shake till dissolved. Carefully strain and store away, tightly corked; it improves by keeping. This glaze imparts a final brightness in place of spiriting out, but has no body for polishing purposes.

Instrument for Locating Leakage of Water.—Herewith is a sketch of a stopcock key and sounding tube combined, which can be made easily and at a small outlay. An instrument similar to sketch has been in use for more than thirteen years at a large waterworks in the South of England, and has been found very valuable for the detection by sound of waste; by using this instrument at the surface considerable success has

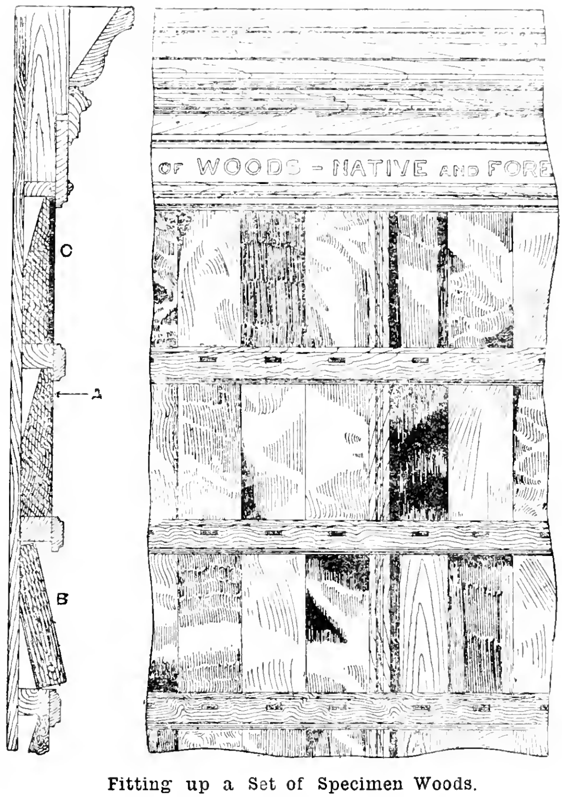


Instrument for Locating Leakage of Water.

been met with in localising underground leaks. The letter references in the illustration are explained as follows. A, face of ear-piece; B, ¼-in. brass tube slide, 18 in. long; C, socket packed between brass bush D and nipple; E, iron tee; F, stopcock cover hook, 3½ in. long, screwed to fit loosely for convenience; G, section of ¾-in. iron barrel; H, soldered joint.

Working and Polishing Alabaster.—Alabaster, although considerably harder than Bath or Caen stone, is worked, like those stones, with toothed saws and steel drags of varying degrees of fineness, first the coarse and then the fine being used. The surface left by the drag is rubbed with coarse sandpaper to remove the marks of the drag, and then with fine sandpaper, all these operations being done in the dry. The surface is next grounded with stone grits and water, as in marble polishing, but the grits in this case are used flat instead of on edge. The grits mostly employed are seconds and snake (water of Ayr), which are sometimes pounded up and used on a worsted wad or boss, the seconds grit first, and then the snake. Then mix in equal proportions powdered sulphur and French chalk, and use on the boss moderately moistened with water, working uniformly over every part, and finally finishing with putty powder (oxide of tin). A little sweet oil rubbed on afterwards brings out the veins, and renders the polish brilliant and lasting. The beginner should practise on waste pieces of alabaster before attempting to polish anything of value.

Fitting up a Set of Specimen Woods.—The following is a suggestion for fitting up about forty specimens of different woods. The specimens might be arranged as shown by the accompanying illustration. The fronts of all the pieces are in line as at C; but any single piece may be taken out by being pushed back near the top at A, when it will assume the position B. The fronts should be



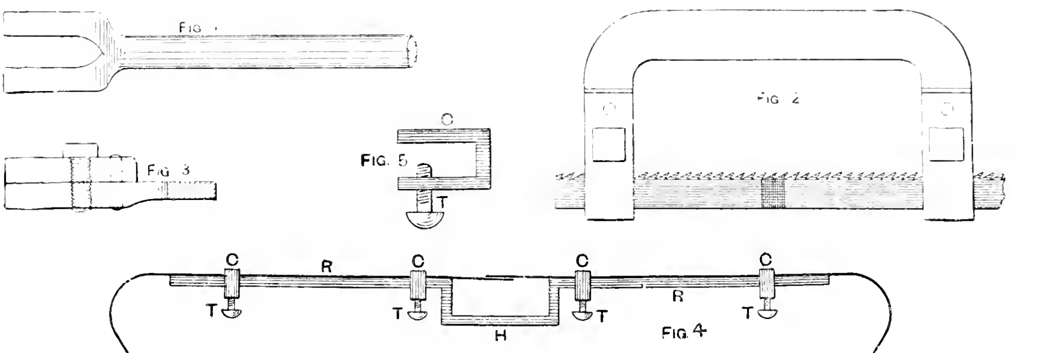
Fitting up a Set of Specimen Woods.

polished. If the pieces are thin they may be backed up to the proper thickness (as at C) by commoner material, in which case only half the front should be polished—preferably a diagonal half.

Winding-in Watch Mainsprings.—In using a mainspring winder for watches, place the eye of the spring on the hook of the winder. With the left hand take the barrel and hold it to the centre of the spring, guiding the spring in the barrel as it is wound up by the right hand. The left hand must grasp the barrel and spring together firmly so as to prevent the spring slipping out as it is wound in. The outer end goes in last with a click.

Moulds for Brass Casting.—Sand, with an almost equal composition, only varying in the size of grain, should be used for moulds for making clean brass castings. It should be composed of about 94 parts of silica, 5 parts of clay, and 1 part of iron oxide. The bulk of the mould may be sand from the new red sandstone formation. The face of the mould should be covered with a mixture of 8 parts of charcoal flour and 1 part of fine sand, or may be dusted with peaflour and then with the charcoal mixture.

How to Braze Band-saws.—By one method of brazing band-saws it is necessary to provide an iron, shaped as in Fig. 1, the two arms of the fork being at least $1\frac{1}{2}$ in. long by $\frac{3}{4}$ in. wide, and welded and attached to a handle of $\frac{1}{2}$-in. or $\frac{5}{8}$-in. round iron, about 2 ft. long. A cramp (Fig. 2) is also required; it is made out of $\frac{3}{4}$-in. by $\frac{1}{4}$ in. iron, and is thickened at the ends to take $\frac{1}{4}$ in. set bolts (see Fig. 3). File each end of the saw for the length of two teeth, and fix the ends in the cramp as shown in Fig. 2, taking care that the saw is quite straight. Twist one loop of iron binding wire round the splice to hold it in place; then bind about a foot or more, according to the width of saw, of soft brass brazing wire round the splice. Moisten the whole with a saturated solution of borax, heat the iron (Fig. 1) to a bright heat (technically known as a spurtling heat), and slip it over the saw so that the splice comes between the jaws. When the brass wire melts and runs into the splice, remove the iron, let the saw cool to a dull red, and then quench in oil, afterwards filing up the braze. Perhaps the most simple and reliable method is to use bright-hot tongs and black-hot tongs. File the ends of the saw taper for the length of two or three teeth, so that when lapped one over the other they will be the thickness of the blade. Damp the ends, then place a little powdered borax and brass spelter between the ends that are being lapped. Heat a pair of heavy tongs in the fire until bright-hot, then close them tightly on the joint until the spelter runs, which will occur, if the tongs are properly hot, in less than a minute. While slipping this pair of tongs off, another pair, made black-hot, must be quickly slipped on by one who has been holding them in readiness, and closed tightly on the joint. Remove these, hammer the joint tightly, and clean up with a single-cut flat file. To set the teeth, lay the blade of the saw on a small steel anvil, the edge of which is bevelled. The teeth must overhang the bevel, and every alternate tooth is struck with a small hammer. When this is done, turn the saw, and treat the remaining teeth in like manner. To correct any irregularity in the set, the teeth should be side-jointed. This is done by placing a topping file longitudinally against the sides of the teeth, and lightly passing it over all the teeth on each side. A rest for the saw can be made from a piece of flat iron, as shown in Fig. 4, where R is the rest. The part H may be held in a vice, or secured to the end of a bench with a clamp. The saw is placed on the rest, and held in position by means of four small clamps C. These clamps are tightened on the saw and rest by turning the little thumbscrews T. Fig. 5 is an enlarged view of one of the clamps. These may be made from $\frac{3}{16}$-in. or $\frac{1}{4}$-in. flat iron; the rest is made from $\frac{5}{16}$-in. or $\frac{3}{8}$-in. flat iron, and must be perfectly straight. When brazing, keep the back edge of the saw fair with the edge of the rest.



How to Braze Band-saws.

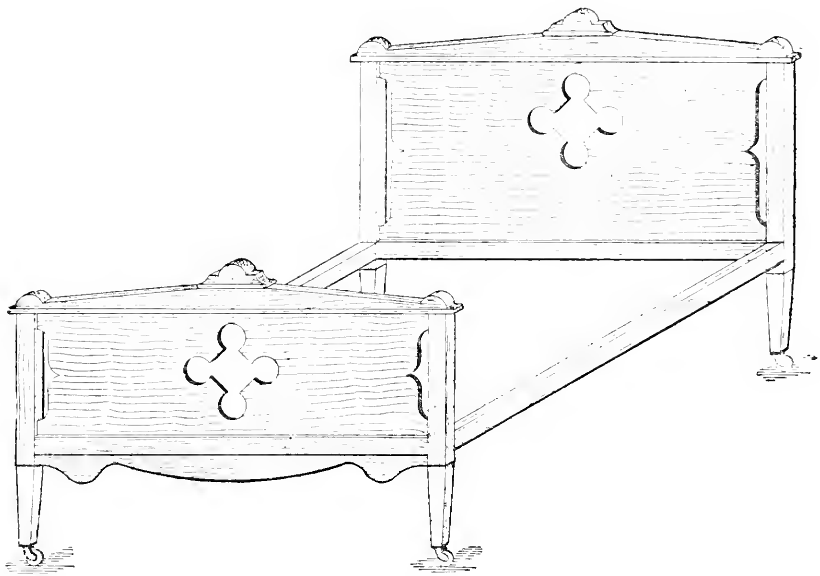
Making and Enamelling Copper Watch-dials.—Briefly, the processes involved in making and enamelling the copper dial of a watch are as follow. The blank, from which the dial is to be made, is prepared by placing a small sheet of copper on a steel die and making a hole in the centre with a conical punch. This produces a conical projection, the top of which is then filed off, and the hole is broached out to accord with the hole in the steel die. The copper is then trimmed to a disc form, sufficient being left on it to form a rim to retain the enamel, and after having its rim thinned down, the blank is laid for a frame and the positions of the feet are marked. The feet may be brazed on with spelter; or, preferably, they may be soldered on with silver solder. To do this, moisten in the mouth a piece of wire having a flattened end, and with it place in position a small piece of solder on the dial, and heat to redness with a blowpipe jet. The silver solder will run, and, on cooling, produce a solid joint without having displaced the foot. The copper dial blank is prepared for enamelling by being cleansed in dilute sulphuric acid, and it is then flattened on a die with the aid of a spatula, and slightly raised to the shape of a lunette. White enamel for copper dials may be made by incorporating, in a molten state, 14 parts of silver sand, 10 parts of borax, 18 parts of red-lead, 2 parts of nitre, 12 parts of oxide of tin, 4 parts of flint glass, and $\frac{1}{10}$ part of binoxide of manganese. Utmost care in selecting the materials, and great cleanliness in using them, are essential, and in most cases watchmakers find it desirable to purchase the enamel ready made. A small quantity of the enamel is put in a muffle furnace, removed when red-hot, and immersed in cold water. It is broken up with pestle and mortar until it is as coarse as sand, uniformity in the size of the grains being essential for successful results. The enamel is mixed into a paste with water, and applied with a spatula to the dial blank, which, after having been tapped to level the enamel, is laid aside. When dry, apply the enamel to the other face of the blank, which should be laid on a block covered with soft wax. When dry, the dial is fired; on cooling, it is carefully examined, spots picked out with a graver, and its surface is ground. A shining surface is imparted by a second firing, the blank having been washed and dried previously. For painting the figures, the white, as the dial blank is now known, has its surface pencilled into divisions while it is attached to a division-plate which has a movable radial rule. The paint used for the figures is a black enamel, capable of fusing at a lower temperature than does the white enamel already applied. The black enamel is finely powdered and worked to the proper consistence with oil of spike lavender. The hour numbers are drawn in roughly, dried by a gentle heat, their ends cut off with compasses having an ivory point, with which the figures are then ruled true. The rest of the figuring is painted in with a fine brush, and the dial is again fired. Whilst still hot, it is placed on a flat ring of fireclay, and, with the aid of a pair of spatulas, is made quite straight and flat. The edge is then smoothed with files and with water-of-Ayr stone, and is then gilt. A hole is cut in the dial to receive the sunk disc that forms the seconds dial, and the edge is bevelled from both of the faces so as to assist the solder in holding the seconds dial in place, the latter having its edge shaped to correspond with the groove in the larger dial. To solder in the seconds dial, run in from the back an alloy (fusible in boiling water) of 5 parts of tin, 3 parts of lead, and 8 parts of bismuth, and after applying a flux a clean and reliable joint will result.

Determining Diameter of Pulleys.—To obtain a close approximation to the diameter of pulley required, multiply the diameter of the driver in inches (say) by its speed in revolutions per minute, and divide by the speed in revolutions per minute required from the driven pulley. Assuming the pulley on the engine-shaft to be 22 in. in diameter, its speed being 220 revolutions per minute, and that the speed of the driven pulley is to be 110 revolutions per minute, the diameter of the driven pulley should be $\frac{22 \cdot 220}{110} = 44$ in. If the required speed were 300 revolutions per minute, the pulley should be about $\frac{22 \times 220}{300} = 16$ in. (say). For greater exactness the thickness of the belt should be known; in making the calculation this should be added to the diameter of the driving pulley and subtracted from the quotient to obtain the diameter of the driven pulley.

Paint for Marking Glass.—For ordinary purposes glass may be stencilled with an ink made by grinding lampblack to a paste with gold size or boiled oil. If the paint is to stand heat, grind to a paste red oxide of iron with fluid silicate of soda, and apply as above. Rubber stamp inks might be made to serve the same purpose if a mineral colour, such as red oxide, were added.

Stripping Gilding from a Silver Chain.—Sometimes the gold wears off in patches from gilded silver and other chains, and it is desirable to remove the rest of the gold, though regilding the chain is generally preferable. To remove the gold, proceed thus: In a basin put a tablespoonful of nitric acid and three tablespoonsful of muriatic acid with an equal quantity of water, and make the whole warm. Carefully swill the chain in this, and well rinse in clean water until all the gold has been removed; then dry the chain and polish it.

Design for Wooden Bedstead.—A wooden bedstead, as illustrated, may be made from sound ash or birch, and, for a full-sized bed, should measure 6 ft. 6 in. by 4 ft. 6 in. over all. The post and rails should be about 2¼ in. square, and the foot and head boards ⅝ in. thick when finished. The height from the floor to the side rails should be 1 ft. 2 in.; the total height of the foot 3 ft. 2 in., and the head 3 ft. 8 in. If the bedstead is fitted with a wire mattress, laths or cords will not be required for the bottom.

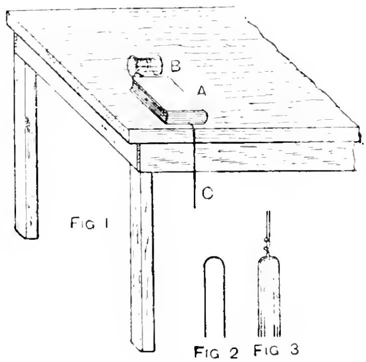


Design for Wooden Bedstead.

Electro-plating with Copper.—The metals on which a coat of copper is deposited by electricity are lead and its alloys; tin and its alloys; iron, tinned iron; zinc; and steel. When articles made of these metals are to be silver-plated, nickel-plated, or gilded, it is always advisable and sometimes necessary previously to coat them with copper. This cannot be done in a copper sulphate solution because that dissolves the metals. Various solutions have been used; but for the most successful one dissolve copper sulphate in hot rainwater. When cold, add strong liquid ammonia in small quantities and stir well with a stick each time. At first a green precipitate will be obtained; then, on adding more ammonia, the green precipitate will dissolve and form a clear azure-blue solution. To this add one of potassium cyanide until the liquid assumes an amber tint, when rainwater should be added. The usual proportions are: Copper sulphate, 1 oz.; potassium cyanide, 3 oz.; liquid ammonia, 1 oz.; rainwater, 2 qt. Distilled water may be used instead of rainwater, but spring and river waters are not suitable because of the earthy matters held by them. The solution should be held in an enamelled iron vessel. If it is kept supplied with free cyanide and free ammonia it may be worked cold at from 6 to 8 volts; but the deposit may be improved by heating the solution to from 150 F. to 170 F., and the vat may then be worked at from 4 to 6 volts. The best generator is a plating dynamo, the next a three-cell accumulator; and among primary batteries the next best would be four ½-gal Bunsen cells. Anode plates of pure copper must be employed; these are connected by No. 16 S.W.G. copper wire to the positive pole of the generator. If the plates do not dissolve freely, but become encrusted with a green slime, a small quantity of potassium cyanide and of liquid ammonia should be added to the solution. The surfaces of all articles to be copper-plated by this process must be cleaned and prepared. Iron and steel articles may be cleaned from rust by steeping and swilling in a pickle composed of 6 fluid oz. of sulphuric acid and ¼ oz. of muriatic acid in each gallon of water. They must then be rinsed in clean water and immersed in a pickle composed of ½ lb. of American potash dissolved in each gallon of hot water. If the surfaces have been pitted, the corroded parts must be polished with emery held on a mop in a polishing lathe, after which the articles must be well swilled in the hot potash pickle to free them from oil and grease. All surfaces must be well polished before the copper is deposited, because the thin coat will not permit much polishing afterwards. Articles made of lead and tin, or their alloys, must be first scoured with sand and water, using a hard brush for the purpose, to free them from oxide; then rinsed in the hot potash pickle; again scoured with finer sand to polish them; wired with short lengths of No. 24 S.W.G. soft copper wire; again rinsed in the hot potash pickle, and transferred direct to the plating vat. The potash pickle will prevent rust forming on iron and steel articles, and will clear oxide from lead and tin and their alloys; but it is advisable to transfer the articles quickly to the plating vat, and not to rinse them in water on the way. Zinc articles are cleansed in a similar manner; but very fine sand or finely powdered bath brick must be used in scouring. If articles are bright and free from rust or tarnish, only a light brushing with a vegetable fibre brush in the potash pickle will be necessary to prepare them. Each article must be attached to a short length of copper wire, which suspends it in the vat. Use No. 21 S.W.G. for small articles, and No. 18 S.W.G. for heavy ones. Each article should be held by the slinging wire during the final rinse, and the free end of this wire is bent over a brass rod on the plating vat, attached to the negative pole of the generator. Move each article to and fro with a rinsing movement when placing it in the vat, to remove any air bubbles on the surface. The current should be regulated by a resistance, usually a long length of German silver wire furnished with a switch. The resistance can also be increased by diminishing the surface of the anode exposed to the plating solution, and by placing the anode further from the article being plated. If the current is too strong, the deposited copper will be dark in colour and loose in character, and this will also happen if the solution contains too much copper. Movement of the articles whilst being plated will assist in securing a bright and smooth deposit.

Some gas is given off from the articles whilst deposition is going on, but this should be regulated by adjusting the current. Only a few minutes is required for plating each article. The plated articles should be rinsed in plenty of clean water to free them from cyanide and copper salts. If the surface is to remain coppery, the article should be rinsed in hot water, placed at once in hot bran or hot sawdust, and moved about therein until quite dry and bright. Pure copper readily tarnishes in the air when damp, but may be brightened with a scratch-brush. If the surface is to be nickel-plated the articles must be rinsed and transferred at once to the nickel-plating vat. If a thicker deposit of copper is desired, use an electrotyping solution, after depositing a thin film of copper in the alkaline solution above mentioned. If the plated articles are to be gilded, get a very thin and bright deposit of copper, or brighten it with a scratch-brush; then rinse and transfer at once to the gilding vat. If they are to be silver-plated, coat with a thin film of mercury before placing them in the silver-plating solution. The solution is made by dissolving 1 oz. of mercury in very dilute nitric acid, say 1 part acid to 10 parts distilled water, then making it up to 1 gal. of solution with distilled water. Give a brisk swill in this, and then rinse in clean water.

Making Small Silk Tassels.—The following particulars are on making silk tassels for banners, etc. On a table lay a large and rather heavy book A (Fig. 1). Place the reel of silk B at one end of the book, and keep the silk C straight, by passing it under the book. Now take the end of the silk in one hand, and in the other hand have a pair of scissors. Draw the silk from under the book, and cut off as many equal lengths as are required, when doubled (see Fig. 2), to make the tassel. The last piece of silk that is drawn should be tied round the centre of the other pieces (see Fig. 3). Then make a second knot a little higher up. Now place close to the first knot a small hard ball, such as a pea, bean, or marble, and cover this with the strands of silk. Tie the ball tight and neat to form the top of the tassel; shake out the strands, and trim off. For more elaborate tassels, machinery and wood moulds are necessary.



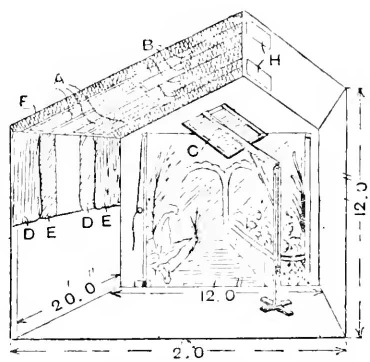
Making Small Silk Tassels.

Fireproofing Fabrics.—To render fabrics fireproof steep them (*a*) in a solution of sal-ammoniac and plaster-of-Paris. Other preparations are: (*b*) Borax 12 parts, Epsom salts 9 parts, dissolved in 80 parts of warm water. (*c*) Sal-ammoniac 2 parts, sulphate of zinc 1 part, water 15 to 20 parts. (*d*) Alum 1 part, phosphate of ammonia 1 part, water 20 parts. (*e*) Phosphate of ammonia 14 parts, sal-ammoniac 7 parts, water 80 parts. (*f*) Alum 6 parts, borax 2 parts, tungstate of soda 1 part, dextrine dissolved in soap-lye 1 part; the dextrine is for the purpose of causing the chemical salts to adhere to the substances being treated. (*g*) Sulphate of ammonia 8 parts, carbonate of ammonia 2½ parts, boracic acid 2 parts, borax 1¾ parts, starch 2 parts, water 100 parts.

Particulars of Fitzroy Barometer.—The barometer known as the Fitzroy has one limb about 33 in. to 36 in. long, the other limb being 2 in. to 6 in. long. This tube is inclined and filled with boiled mercury, and on inverting it the mercury falls, leaving a vacuum several inches in length in the upper part of the long limb. There should be 2 in. or 3 in. of mercury in the short limb to prevent air getting into the tube. The mercury rises and falls with the pressure of the air which is exerted on the surface of the mercury in the short limb, and in order that it may do this the short limb must be open or a hole must be blown in its side. The indicator is a metal pointer, which is moved to the upper surface of the mercury from day to day; it simply shows how the barometer stood the day before. Usually there is a dial on this form of barometer, and a pointer that moves round the dial; the pointer is actuated by a string and a weight in the shape of a glass rod, which rises and falls on the surface of the mercury in the shorter limb.

Electro-bronzing.—Electro-bronzing can be done with an alkaline coppering solution made as follows. Dissolve 2 oz. of copper sulphate in 1 quart of hot water; add this to ½ gal. of rain-water containing 4 oz. of potassium carbonate; then add 2 oz. of liquid ammonia, and stir until the green precipitate has been dissolved; mix this liquid with a solution of 6 oz. of potassium cyanide in ½ gal. of rain-water, and filter for use. This solution is best worked at a temperature of 100° F., but can be worked cold, with current at a pressure of from 6 to 9 volts. It deposits a bronze-coloured copper at low temperatures with the higher voltage. The bronze tint may be deepened by rinsing the coppered goods in a solution of sal-ammoniac.

Construction of Photographic Studio.—The accompanying illustration shows a photographic studio and the manner of fitting it with blinds A and B and a head screen C. The blinds A are frames covered with muslin, and run in grooves. Two rows of blinds of different material may be fitted and arranged so as to overlap so that perfect control of lighting may be obtained. The blinds B are on spring rollers, and pull down from the roof. The head screen C may be swung at any angle or from side to side and fixed with thumbscrews. There is no advantage in having both sides of the studio glazed, though it is sometimes useful in taking Rembrandt pictures, or when the studio faces east and west. About 3 ft. from each end F may be left opaque, as the ends are never required. It is most important to be able to take the left side of the face when looking away from the light. Much, however, depends upon the situation and surroundings. The curtains D and E run loosely on a brass rod. The ventilators are shown at H.



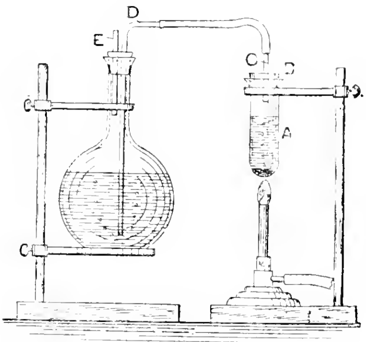
Construction of Photographic Studio.

Fixing a Loose Endstone in a Geneva Watch.—When the bottom endstone of a Geneva cylinder watch is "fixed," it is set in a small plate of brass and held by a screw to the "chariot." To replace the fixed endstone by a loose one, push out the fixed stone from its setting, hollow out the setting from the inside a little with a round-faced chamfering tool, to cut away the sharp, rough edge, and pick out a loose endstone that will just lie flush in the hollow. Then place the loose endstone (shaped like a minute plano-convex lens) with its flat on the jewel hole and the round side up, lay the small piece of flat brass over it, and screw it down as before. The brass plate will then hold the endstone tightly against the jewel hole. No cement of any kind is required.

Making Electro-gilding Solutions.—Electro-gilding solutions are made with cyanide of gold dissolved in a solution of cyanide of potassium. Use 3 dwt. of gold cyanide in each quart of distilled water, and add just enough potassium cyanide to dissolve the gold. Work at 150° F. with a 2-volt to 3-volt current, using a pure gold anode.

Distinguishing Pebble Lens from Glass.—Pebble lenses may be distinguished from common glass spectacle lenses in the following manner. If the tip of the tongue be placed on a piece of glass it will feel rather warm and smooth, or woolly; but if the tongue be placed on a piece of quartz it will be cold, with a peculiar crisp feeling. Another test is hardness; a crystal of quartz will readily scratch glass, but the crystal will run over a pebble without leaving any scratch. A natural stone is a much better conductor of heat than any glass, and so to the tongue will feel cold; and being a variety of quartz, it will not be scratched by another crystal of quartz. If the pebble is supposed to be, say, a topaz or a ruby, then, being harder than quartz, it will in its turn scratch quartz. If the pebble is a diamond, then it will scratch a ruby or sapphire. Another rough and ready method of testing hardness is to pass a small fine-cut file over the edge of a bit of glass; there will be a somewhat dull, cutting sound emitted. If the file be passed over a bit of quartz the sound will be clearer and sharper.

Permanence of Toned and Untoned Prints.—An untoned print is not so permanent as one that has been toned; indeed, the object of toning is to protect the easily affected silver in the print by coating it with a metal that is better able to resist adverse influences. The value of toning may be demonstrated by the following experiment. Prepare some sulphuretted hydrogen water (SH_2) by placing a small piece of iron sulphide in a test tube A (see sketch), half filling it with water, and adding a little sulphuric acid. Fit a cork B, bored to take a length of glass tube C. Fit up a glass



Apparatus for Testing Photographic Prints

flask with tubes D and E, and nearly fill with distilled water. Connect D and C with a length of rubber tubing. Now warm the test tube in a gas flame, and the gas will readily be driven off through the tubes, and eventually bubble through the water in which it dissolves. Allow the action to continue spontaneously for an hour. This operation should be performed out of doors. Cut in halves two prints—one that has been toned a decided blue, and the other untoned. Place one half of each print in the SH_2 obtained from the flask. Both pieces will become lighter, and will be altered in appearance, as will be seen on comparison with the untreated halves. On removal from the SH_2, the toned print will be found to have faded equally with the other, but will be less altered otherwise.

Solution for Whitening Electro-plate.—For whitening letters engraved on electro-plate, dissolve 5 dr. of silver nitrate in ½ pt. of distilled water, and add enough potassium cyanide solution to throw down the silver in white curds, and then to dissolve these curds. Procure a strip or a stout wire of pure silver, wrap a few folds of cotton rag round one end to form a small mop, and connect the other end to the silver or copper plate of a Smee or Walker battery of one or two cells. Connect the engraved plate to the zinc plate of the battery, soak the mop in the silver cyanide solution, and pass it along each line until all the lines are nicely silvered.

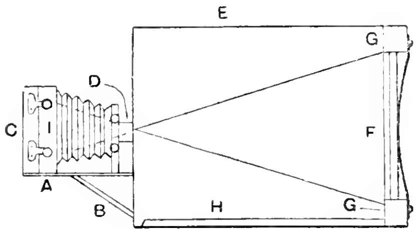
Determining Contents of Cylindrical Vessels.—To find the contents of cylindrical vessels in cubic inches, square the diameter of the vessel in inches (that is, multiply it by itself), and then multiply by ·7854 and by the height in inches. To find the contents in cubic feet, take all dimensions in feet. Knowing the contents in cubic inches, divide by 277·274 to find the contents in gallons. Dividing the contents in cubic feet by ·16045 answers the same purpose. Shorter methods will suggest themselves from the following. A cylinder 1 ft. in diameter and 1 ft. long will hold 4·89 gal., and a cylinder 1 in. in diameter and 1 ft. long will hold ·034 gal. Also, capacities vary with the lengths of the cylinders and with the squares of the diameters. Thus a cylinder 1 ft. in diameter would hold 12 × 12 = 144 times the contents of a cylinder of equal length but 1 in. in diameter.

Encaustic Paste for Photographs.—Encaustic paste, used for polishing photographs, has the following composition. Pure wax, 500 parts; gum elemi, 10 parts; benzole, 200 parts; essence of lavender, 300 parts; oil of spike, 15 parts; apply this paste after the print is mounted.

A Simple Oil Filter.—A simple oil filter may be made from two clean meat tins placed one above the other; in the upper tin, with a bradawl, punch a number of small holes, and over these spread a piece of flannel.

Hard Soldering with Silver Solder.—In hard soldering with silver solder, first file or scrape the parts bright, and cover them and the solder with a paste of borax and water. Heat gently at first so as to harden the borax; then continue to heat by blowpipe until a red heat is reached, at which the solder will run. The secret is to blow continuously until the solder runs, and not to stop half way.

An Enlarging Camera.—These are brief instructions on fitting up a camera for enlarging to whole-plate, using a ¼-plate Instantograph lens. The camera consists of a light-tight box E with rails H, along which runs a whole-plate printing frame G, grooved to fit. The camera I is placed upon the level platform A supported by B, and racked out to the correct extension. The negative C is then placed in the position usually occupied by the focussing screen. An image is projected through the lens D on to a sheet of bromide



An Enlarging Camera.

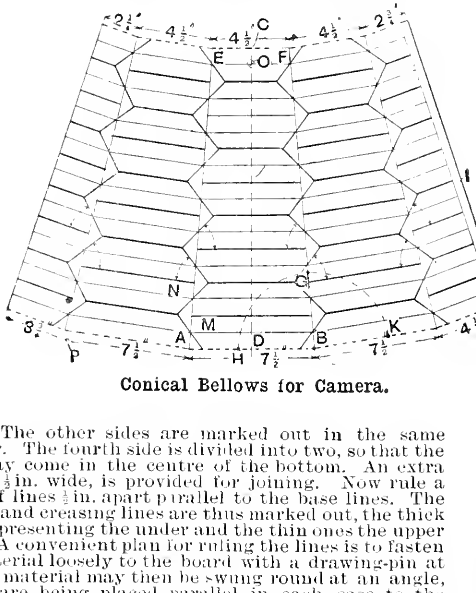
paper placed in contact with the glass F, the frame having been adjusted to the correct distance from the lens along the rails. If a fixed focus camera (which will be found very inconvenient to use) is preferred, the box need only be fitted with a hinged and light-tight door, on which the bromide paper is pinned. If the focus of the lens is 5 in. the box must be 15 in. long if fixed, or 17 in. with the frame and the small camera extended 7½ in. Procure a whole-plate frame and make the box to fit. To focus, place a sheet of ground glass in the printing frame.

American Clock Striking Wrong.—When an American clock, after being wound up, continues to strike until it runs down, the remedy is this. Take off the hands and dial and watch the clock strike. It will be seen that at each blow of the hammer a wire bent at a right angle and hammered to a thin edge drops into the spaces between the teeth of a large wheel on the left of the clock. In this wheel, at irregular intervals, are deeper slots. First see that the wire drops centrally into these and does not touch either side. This can be adjusted by bending the wire. If this does not remedy the fault, look to the next wheel. On its axis there is a circular brass plate with a slot in it. When the wire first mentioned drops into a deep slot in the large wheel, another wire arm should drop into the slot on the next wheel and so stop the striking train. Allow the clock to strike very slowly by checking the fly with the fingers, and observe very carefully whether the wire lever last mentioned drops properly into the locking slot. If it does not go deep enough, bend it down a trifle.

Re-soling Rubber Shoes.—A fresh layer of rubber may be attached to the soles of a pair of rubber sand-shoes in the following manner. Put the shoe on a last, and rasp the old sole all over till it is quite clean and rough. The new sole must also be treated in the same way, and the dirt and dust brushed out. Now give both the old and new soles a coat of very thin solution, and when dry give another coat (or two if required) of slightly thicker solution. When tacky, heat both the sole and the bottom of the shoe, so that the spirit left in may evaporate; then place the two together, drawing the sole a shade tighter, so as to give it a little tension.

Soldering Britannia Metal.—Britannia metal may be soldered with pewterers' solder, which may be made of 2 parts of bismuth, 1 part of lead, and 1 part of tin. Such a solder is usually obtainable of any dealer in metal-workers' sundries; or it may be made by melting the lead in a plumber's ordinary ladle, and adding the tin and bismuth. A little resin should be sprinkled on the surface to prevent oxidation of the molten alloy, which should then be well stirred, and poured into an iron mould. When using the alloy, with a sharp knife first scrape the metal where it is to be soldered, and then rub a little tallow over the cleansed part. Melt some solder from the stick upon the part to be soldered, and, with a fine jet from a blowpipe, blow gently on the solder until it flows over the parts to be joined.

Making Conical Bellows for Camera.—Imitation leather and black twill joined with thin glue and flour paste are suitable materials for the conical bellows for a camera. The paste should consist of 4 parts of thin glue to 1 part of flour, the latter rendering the paste less likely to crack. Two thicknesses of twill should be used. Take a piece of leather and a piece of twill, each 1 yd. by ½ yd., and join and pin down on a board, inside uppermost, having first well rubbed the board with chalk. Draw a line A B in the centre at the bottom, say 7½ in. long, and from the centre of this erect the line C D, and at 18 in. from D draw the line E F parallel to A B, say 4½ in. long, to fit the rising front. Now join the points A E and B F. Now place the blunt point of the compasses at B and with any radius describe an arc of a circle; then with the point G where the arc cuts B F measure the distance G H, and with the same radius mark off at K and draw a line from B through K 7½ in. long. This gives the angle for the



Conical Bellows for Camera.

sides. The other sides are marked out in the same manner. The fourth side is divided into two, so that the join may come in the centre of the bottom. An extra piece I, ½ in. wide, is provided for joining. Now rule a series of lines ½ in. apart parallel to the base lines. The folding and creasing lines are thus marked out, the thick lines representing the under and the thin ones the upper lines. A convenient plan for ruling the lines is to fasten the material loosely to the board with a drawing-pin at O. The material may then be swung round at an angle, a T-square being placed parallel in each case to the longer thick line as M, N and so on, or parallel alternately to A B and A P, the other lines being ruled on each side in the same fashion. The diagonal lines are put in with a set-square, so that the angles marked are 45°, the other lines being parallel to them. Cut off the surplus, join up, and crease into shape with the fingers. The heavy lines are best put in with the stylus, which will show them on the reverse side in white chalk. It is advisable first to practise the ruling and creasing on some brown paper. Bellows can be purchased ready made very cheaply.

Keeping Fish in Tanks.—In a fish tank, its size, the number of the inhabitants, the presence or absence of snails and vegetables, and the source and nature of the water supply, are important factors. Several gold fish and carp would in a small tank soon exhaust the supply of oxygen, while their products would still further impoverish the water. If a white powder covers the bodies of the fish it is of fungoid growth, but the cause has been much debated. Still, it is generally agreed that nitrogen is necessary for the growth of every kind of fungus, and therefore it is reasonable to say that nitrogenous matter in solution must be in excess. This may be the result of the decomposition of animal matter, and the best way to correct it is by adding oxygen to the water mechanically by causing a circulation of water, either by a fountain playing and thus entraining air among the falling drops, or by allowing a stream of water to pass through the tank. A cruder method would be to suspend a leaking vessel above the tank, thus allowing water to fall, taking air with the drops. A natural method would be to add growing water-weeds, and thus allow them to give oxygen to the water. In some cases lime in the water has been held to be a cause of the powdery appearance, but lime is not a necessity to fungi. The affected fish may be quickly cured by placing them in a vessel into which water is constantly dripping from a tap.

Removing Fur from Kettle.—A simple plan for removing fur from a kettle is to boil some common whiting in the vessel (watch carefully, as it soon froths over) and wash out. If necessary, repeat the process and then scrape out the softened fur. This does not damage the vessel as chiselling is apt to do. A wire should be passed up and down the spout until clean.

Making a Postage Stamp Damper.—To make the damper, fit in a small jam jar a sponge. Now from a cigar box make a box (Fig. 1), which can be polished or varnished, the bottom being in two pieces; the extreme bottom E (Fig. 2) has a keyhole cut in the centre before

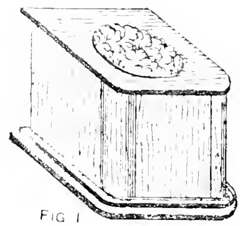


FIG 1

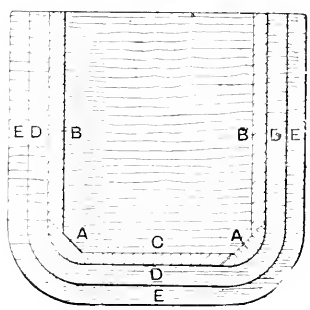


FIG 2.

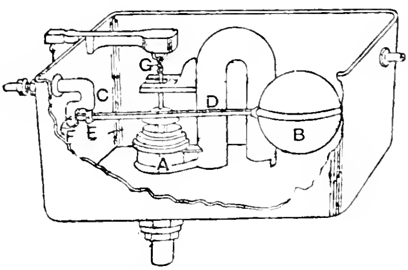
Postage Stamp Damper.

fitting together. A groove is cut for a screw head (passing through the keyhole) to run in; and by means of a screw inserted in the table on which it rests, the box is easily locked or removed. First nail the two sides B and front C of the box to the bottom D, then bevel off the corners with the chisel or knife, so that two corner pieces A can be fitted on flush. Nail on the top, which must overhang slightly at the front and sides and which must have a hole rather smaller than the inside of the jar, through which the sponge in the jar protrudes. Fit the two corner pieces on, and chisel them to shape as at A (Fig. 2) after fixing. The jar can be easily withdrawn through the open back for re-filling.

Bending Brass Tube.—A piece of 1½-in. brass tube may be bent in the following manner. First carefully anneal the tube, and when it is cold, tie brown paper over one end, and insert this end in sand. Now melt enough lead to fill the tube, and pour it into the tube from a plumber's ladle. In a firmly fixed bench cut a hole a little larger than the tube, and chamfer the sharp edge round the hole. Remove the paper at the end of the tube, and pass the latter through the hole in the bench to the desired position of the bend. Pull the top end of the tube over against the rounded shoulder at the top of the hole; pass the tube a little farther through the hole and again bend, and repeat until the desired curve is obtained. Bruises in the throat of the bend may be worked out with a round-faced hammer; then re-heat the tube until the lead flows out and leaves the interior clear.

Pitch of Heavy Cart Wheels.—The pitch is governed by the dish of the wheels; thus, a wheel having 1½-in. dish would lay out more than a wheel having only ¾ in. The general rule when setting out the wheels is that the face spokes in the bottom halves shall be parallel with each other—that is, square up from the ground line, no matter what dish there is. To obtain the length of the axle-tree, having set the wheels out to the required width for the track, hold a short straightedge on the back of the nave, parallel with the spoke, measure the distance from the straightedge to the back of the tyre, and deduct twice this measurement from the inside width of the track; this will give the length of the axle-tree at the shoulders.

Repairing Flushing Cisterns.—To remedy the constant flow of a small stream of water down the side of a water-closet basin, first empty the cistern by pulling the chain. If, while the cistern is being refilled, the flow of water continues, the plug (or valve) A in the bottom of the cistern requires a new washer. In repairing, cut the wire G and lift out the plug A. Unscrew the nut which secures the washer to plug A, and replace the old washer by a new piece of thick leather of the same size as the old piece; replace the nut, and screw up tightly. Put new wire in place of G. Should the flow cease while the cistern is being refilled, lift (with the hand) the ball B; if by so doing the cock C (in the tap by which the cistern is filled) is closed, there is water inside the ball B. If cock C is not closed by lifting the ball, it requires a new rubber washer. To insert the washer, remove the pin F (which secures arm D to lower part of C), and remove D from C; slide the part E (which holds the washer) off D; this is in two parts. Unscrew the cap (containing the washer) from the under part. Remove the washer, and replace it by a new piece of insertion sheet rubber. Screw parts of E together and fix lever, etc., in old position by means of pin F.



Repairing Flushing Cisterns.

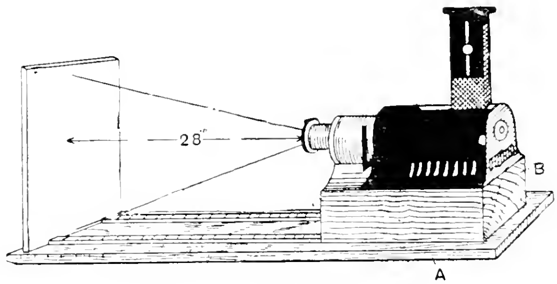
Lacquering Brass.—Lacquer for brasswork is made by dissolving best pale shellac in cold spirit of wine, and colouring it with gamboge, saffron, or dragon's blood, according to the tint required. The articles to be lacquered are first thoroughly cleaned by dipping in diluted sulphuric acid and rinsing in clean water, so that the colour of the metal is fully exposed. They are then laid on a stove (a sheet of iron with a gas-jet beneath it being sufficient for small articles) and heated, but they should not be made so hot as to colour the metal. The lacquer is then carefully applied to the hot metal with a small soft brush.

Bronzing Lead.—Lead can be bronzed by coating it with spirit varnish or with lacquer, and then rubbing over with bronze powder before the varnish dries hard. Or the lead can be painted any desired colour and then bronzed. A mock bronze is produced by painting the lead of a yellow colour and then, when dry, with a green or brown of the desired shade, some of the latter being wiped off to partially expose the first coat.

Sharpening Circular Saws.—When sharpening a saw with an emery wheel, apply the wheel to the face of the tooth whose set points from the operator. If the saw is ground against the set, that is to say, with the set pointing towards the operator, there will be some jarring, and consequently a less keen cutting edge. The fringe or burr caused by filing or grinding indicates that the face or top of the tooth, as the case may be, has been filed or ground to a keen edge; this burr, after a little work, disappears. If desired, the burr may be removed by a light touch with the topping file. The writer prefers to top the saw teeth with a second-cut topping file; this is better than topping them with an emery wheel. The faces of the teeth cannot be filed as accurately as they can be ground, and the tops cannot be ground as perfectly as they can be filed. Before taking the saw out of the sharpening machine, give each tooth a light wipe with the emery wheel; this will remove a portion of the burr and any little hardness that may have been caused in grinding. By omitting this trifling detail, great difficulty is often experienced, and expense incurred, when topping with a file.

Casting Brass.—To judge when melted brass is at the proper temperature for pouring is a matter of experience. If the metal be too hot, porous castings will result; if too cold, the mould will not be perfectly filled. A useful guide is to draw the pot immediately the metal gives off bluish white puffs of vapour, which is volatilising zinc; the latter is a part of the alloy. The heat of the metal will vary according as the castings are wanted large or small. The smaller the casting, the hotter is the metal.

Lantern for Enlarging Photographs.—An ordinary lantern for 3¼-in. slides could be used for enlarging negatives of that size or smaller, but the condenser should always equal in diameter the diagonal of the plate. For vignettes, where only the centre of the negative need be evenly illuminated, a smaller condenser can be used. Artificial light enlargements, especially those made with a condenser, are always inferior to daylight enlargements, as the working up of the negative is always made more or less visible, and there is, besides, a certain amount of hardness and granularity apparent. The illustration shows a method of fitting up, the negative being projected on to the bromide paper in the same way as slides are shown. It is essential that the negative and bromide paper be exactly parallel. To ensure this, make a board A 40 in. long, and screw down parallel rails on which an upright board 13 in. by 11 in. may run. Screw a block B to fix the lantern also parallel and central. The distances between board and slide may be marked out in inches and fractions of an inch. An achromatic lens or one corrected for photography must be used, or the enlargements will always be fuzzy, even if the extension is corrected for the chemical rays. Use the full aperture of the lens, which may be about 4-in. or 5-in. focus. To enlarge from 2 in. to 12 in. by 10 in., the distances with a 4-in. lens will be: From slide to lens stops, 4⅘ in.; from lens stops to bromide paper, 28 in. Carefully centre the light after setting the distances, and insert the negative and focus sharply on the white board. Then cap the lens and pin up the bromide paper, and expose. Find the best exposure by first trying a small piece of paper. Cover the lantern lest extraneous light should reach the bromide paper. Develop, etc., as usual.



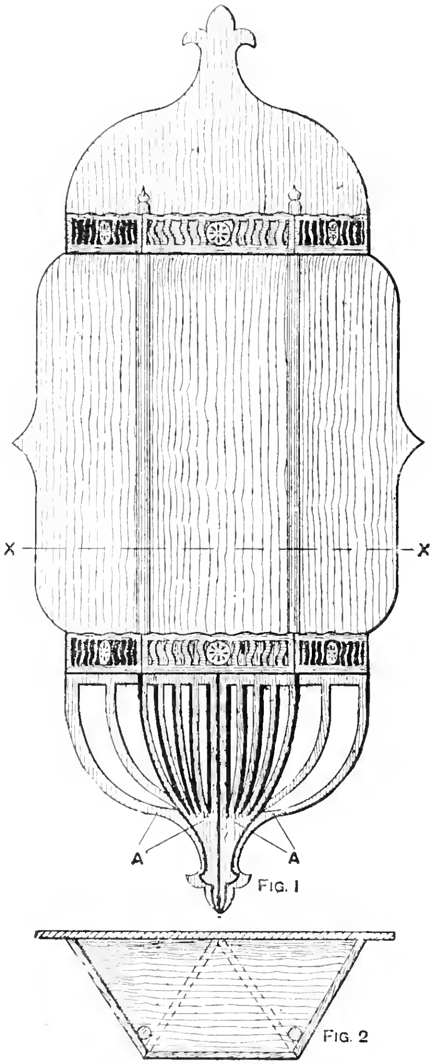
Lantern for Enlarging Photographs.

Printing in Gold and Silver.—The printing is done in the ordinary way, gold size or varnish being used instead of ink, and then, whilst the impression is still tacky, it is brushed over with a soft brush dipped either in silver or gold powder. The sticky letters retain enough powder to cover them, the surplus being brushed off. Embossed letters are done in an embossing press furnished with dies.

Rosewood Graining on Glass Signs.—Skeleton letters, corresponding in shape and position, etc., with the carved or gilded letters of the sign, are written in gold (burnished) on a piece of glass that has been cut to the exact size of the sign. The glass is then grained with water-colour, vandyke brown and drop black ground in beer, or oak or marble may be used. When this is dry, the background, composed of venetian red ground in varnish, may be added with a pencil, leaving the skeleton letters uncovered. When the ground is dry, wash off the graining colour from the letters, place the skeleton on the sign, and the carved or gilded letters of the sign will show through the skeleton letters.

Cleaning Old Pewter Teapot.—An old pewter teapot may be cleaned by boiling in strong soda-water, well brushing to remove dirt. Mix to a thick paste in good sweet oil 3 parts of flour emery powder and 1 part of crocus powder; with this rub the teapot, and polish off with dry rottenstone.

Making an Ornamental Bracket.—The bracket illustrated, when constructed, should be painted white and then enamelled white or cream. The over-all dimensions are 3 ft. 9 in. by about 1 ft. 6 in. The back is in one piece. The outline (see Fig. 1) can be cut with a bow-saw or coarse fret-saw; the latter must, of course, be employed

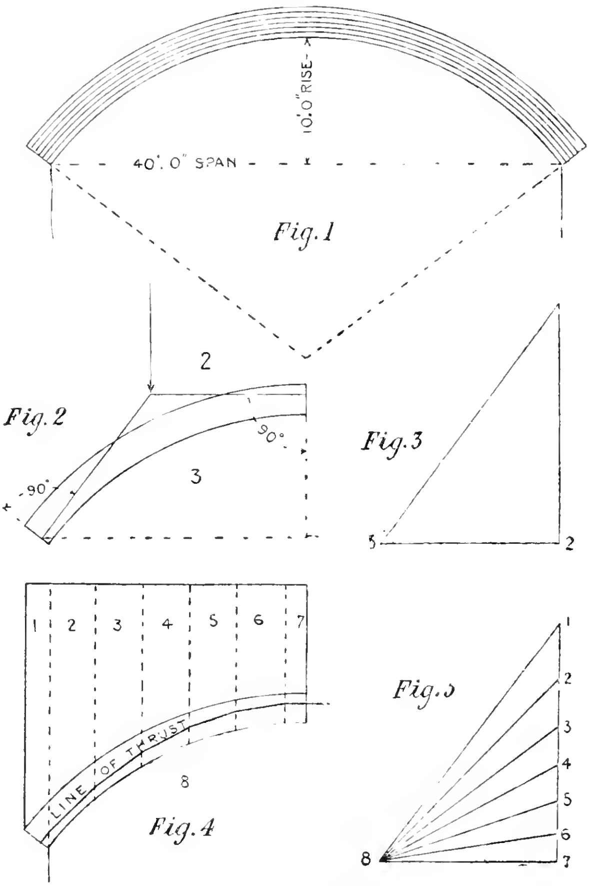


An Ornamental Bracket.

for the under part and details. The ordinary fret-saw will do, as no turning is required. The two pillars, which can be ornamented if desired, may be purchased. The shelves and under-pieces A (Fig. 1) are screwed on from the back. The bordering, 7½ in. long to the shelves, is glued on. The shelves are 1 ft. 3 in. long at the back, the front and sides measuring 7½ in. The under pieces A are 12 in. deep by 7½ in. wide at the top. Two holes are cut just above the top shelf, where they do not show, to receive brass-headed nails for hanging the bracket, and a nail is inserted at the foot to steady it. A mirror inserted in the back is an improvement; or photos could be covered with glass and placed in position, and an ornamental beading tacked round, thus forming frames. A small oil painting treated in this fashion looks well. Fig. 2 is a section on line X X (Fig. 1), the two front under pieces being indicated by dotted lines.

Protecting Corks from Chemical Action.—It is doubtful whether any treatment would prevent corks used as stoppers for bottles or flasks being acted upon by chemicals. It is usual to treat corks with melted paraffin wax, the corks being kept in the melted material for several hours. Cerasin wax is a better material, and has a higher melting-point. For this purpose, steep the corks for several hours in silicate of soda solution (1 part of silicate to 4 parts of water), and then in lime water for several hours. They can be waxed afterwards, if desired.

Strength of Brick Arch.—Here are hints on finding the strength of a brick arch by calculation, and also by



Strength of Brick Arch.

construction. An example in which the span is 40 ft. and the rise 10 ft. is worked thus:—

Span 40 ft. and rise 10 ft. will give,

$$\text{radius} = \frac{\frac{(\frac{1}{2}\text{ span})^2}{\text{rise}} + \text{rise}}{2} = \frac{\frac{20^2}{10} + 10}{2} = 25 \text{ ft.}$$

One rule for thickness of brick arch at crown $= \cdot 4 \sqrt{\text{radius}} = \cdot 4 \times \sqrt{25} = 2$ ft., in this case $= \frac{24}{4\frac{1}{2}} = 5\frac{1}{3}$, say six half-brick rings. Another rule for railway viaducts is, number of half-brick rings $= \frac{\text{span in feet}}{6 \text{ or } 7} = \frac{40}{6 \text{ or } 7} = 6\frac{2}{3}$ to $5\frac{5}{7}$, say six half-brick rings. Then draw the arch, as in Fig. 1. From experience of the usual course of a line of thrust under a distributed load in a circular arch, it may be assumed that at the crown it will be at the joint between the fourth and fifth rings, while at the abutment

it will be between the second and third rings, so that its whole outline will occupy the middle third of the depth of arch ring. From these points draw lines at right angles to the thrust, and they will intersect at the spot where the half load may be considered to be applied. Before the reciprocal diagram of those forces can be drawn, and the amount of the load ascertained, the value of the horizontal thrust must be assumed; thus, suppose the maximum safe load to be 10 tons per square foot on brickwork, then the mean pressure over the whole depth of arch will be 5 tons per square foot, or with an arch 2 ft. 3 in. deep, a total pressure per foot run, through the arch, of 11·25 tons; this will be the measure for line 2—3 in the stress diagram (Fig. 3); then drawing 3—1 parallel to the thrust at abutment in Fig. 2, and a vertical line for 2—1 to intercept it, the stress diagram is made complete, and from this the value of 1—2 is measured off. This will be the load on half of the arch, and double it will be the total distributed load on the arch, including weight of brickwork. It should then be checked by working the reverse way, starting with a distributed load, and finding the line of thrust and maximum pressure, as in Fig. 4 (stress diagram, Fig. 5), where the load on the arch is translated into cubic feet of brickwork placed above it, and the area of each 4-ft. width taken for weight on that part.

Making a Head for a Waggonette.—Below are given instructions on making a waggonette head. Fig. 1 shows a side view and Fig. 2 a back view of the head as finished, worked out to desirable sizes. Birch seats, as shown at A in the section, Fig. 3, can be used, the pillars being half checked into them, and the seats being strengthened by light steel plates across. The two standing pillars to form the doorway at the hind part are 1½ in. wide, got out to the size of the door pillars in Fig. 4, and let in to the end of the seat, having a 1½-in. half-round plate fixed on the top of the seat and up the pillar for about 1 ft. The four corner pillars, 2 in. square, are got out to the shape of B (Fig. 3); the four pillars to form the side lights are 2 in. thick by 1½ in. wide, and when in place should measure 1 ft. 9½ in. between. The cant-rails C (Fig. 3) are 2¼ in. deep by 1½ in. thick, and the front and hind roof cross-bars 2½ in. wide by 1⅝ in. thick; these are stoutly made, to give a good fixing for the iron eyes, by which the head is slung up when not in use. In panelling round, ½-in. birch may be used at the bottom part D (Fig. 3), screwed to the pillars and seats, the top edge going above the bottom edge of the top quarter panels ⅜ in., and being planed off on the outside to give a level bearing. The top panels are of mahogany or white wood full ¼ in. thick, well canvassed on the inside, fixed on with panel pins, and mitred together at the corners; the roof boards are of ⅜-in. yellow pine, covered over with moleskin or prepared canvas, being brought well over the edges and tacked; a ¾-in. wood cornice is afterwards put on to hide the tacks and give a finish, also to prevent rain running down the sides. To hide the screws fixing the bottom panels, mouldings 1⅛ in. wide and full ¼ in. thick are planted on, mitred at the corners, and cleaned off level with the top panels. The overhang (2½ in.) at the back of the body is taken up by the thickness of the door pillar, but should it be necessary to make the overhang wider at this point a fillet can be screwed on inside, or the door bottom can be made wider than the pillar. The door pillars are 1½ in. thick, got out to Fig. 1, from which it will be seen how the glass course is boxed out. The fence rail of the door may be made in the solid, 1 in. thick, and boxed out at the top part, or a piece ⅜ in. thick can be screwed on and panelled to form the moulding. It is customary to have single or double sliding glasses in the front. If double, they should work sideways, as in a brougham; if single, up and down, when suitable provision must be made in the pillars. For fixing the head, the same method as is employed for the seats should do, the holes through which the key-bows pass being got in the plates on the seats if possible.

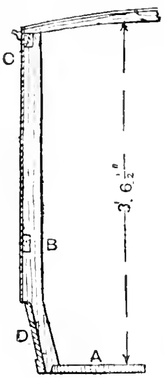


FIG. 3

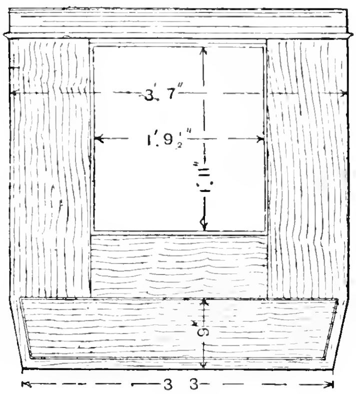


FIG. 1

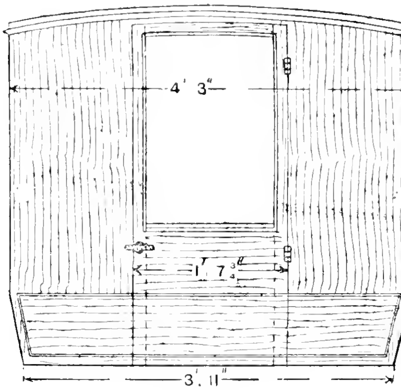


FIG. 2


FIG. 4

Making a Head for a Waggonette.

Pearl Inlaying on Metal.—"Pearl inlaying" is the name given to a process by which pieces of pearl are attached to the surfaces of metal and sometimes of papier-mâché. Mother-of-pearl, known also as pearl oyster and white pearl, is chiefly used for the purpose. It has a clear white surface covered with minute grooves which decompose and reflect the light, imparting a number of beautiful tints. Aurora shell is used; this has a wrinkled appearance and is known also by its various colours. It is made from the shell of the mollusc known as the sea-ear or ear-shell. Another pearl used for the purpose comes from the green snail shell; this is distinguished by its glistening shades of green, yellow, and pink, blended together. In preparing the pearl for inlaying, the rough shells are cut with fine saws, the pieces being then ground on both sides on a grindstone until of the requisite thickness. With a pair of ordinary scissors the pearl is now cut into the form of leaves, flowers, etc., or when many pieces of the same size and shape are required, a die press operated by foot-power may be employed. Another method by which a number of similar pieces may be obtained consists in gluing the several thicknesses together and, holding the composite lump in a vice, shaping with a fine saw. Files and drills also assist in the shaping. Soaking in water will separate the pieces, from which the glue can then be washed. To prepare the iron or other material to receive the pearl, it should be well cleaned and then coated with lampblack worked up with varnish. When this is thoroughly dry, a coat of black japan is applied, and when this is tacky the pieces of pearl are pressed on with the finger. Being left two or three hours in a hot oven, the japan dries, and then the whole is varnished and again stoved, this process being repeated several times. The varnish should be applied thickly, so as to bring up the surrounding surface to the level of the pearl; the varnish is scraped off the latter with a knife when the stoving operations are finished. The pearl is then polished with pumice-stone and water, and the varnish is rubbed smooth with very fine and wet pumice powder. The article now has the appearance of being inlaid, if the film of varnish applied is sufficiently thick. It is obvious that the whole process is not one of real inlaying. The next stages of the work can be successfully carried out only by a person possessed of an eye for the artistic. The pieces of pearl are made to assume the forms of flowers, etc., their stems and leaves being sketched in with a camel-hair pencil dipped in gold-size or in a mixture of varnish and turpentine. When tacky, gold-leaf is applied, superfluous gold being rubbed off with a piece of silk when the size or varnish is dry. The flowers and leaves are further touched up with paint, and the job is finished by coating with the very best varnish.

Covering an Octagon Dome with Sheet-lead.—If the roof is already constructed, horizontal lines should be drawn between the hip rolls at equal distances (say 6 in.) apart, measured on the surface of the roof as shown in the elevation half of Fig. 1. The lower half of the figure, and the vertical dotted lines, are drawn only as aids to finding the true position in the elevation of the hip rolls to the centre bay, so as to be able to measure the width of the latter at all parts. Similar horizontal, and a centre perpendicular, lines are to be drawn on the piece of lead to be used, and the dimensions transferred one at a time from the roof to the lead, and the points joined together by freehand, as shown by Fig. 2. Outside the lines thus found, draw others 4 in. and 8 in. distant for the under-cloak and over-cloak respectively. The sides of the bay are then bossed upright; or, if the contour of the roof is very round or very hollow, they can be doubled down flat until placed in position, and afterwards worked up and dressed to the rolls. If the bays are not very large, the nailing on the top end, and also the under-cloaks to the rolls, will support them. With a roof of this shape the grip of the metal on the rolls will also help to support it. If the bays are put on in two pieces, or if laced rolls are used between the hip rolls, further support is obtained without the use of soldered dots. About three copper tacks can be used for each bay to hold up the bottom edge. The covering for the top should be bossed out of a round piece of lead, and the bottom edge should lie on the roof about 6 in. to 9 in., to cover the nailing and make it watertight at that point. Copper nails should be used in preference to iron nails.

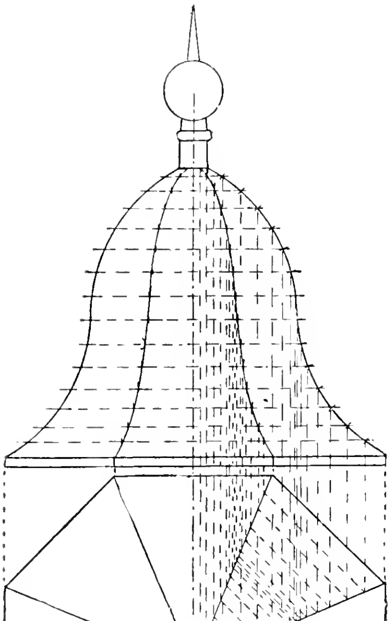


FIG. 1

Glazing Photographic Prints.—A good polish can be applied to P.O.P. prints in the following manner. A thoroughly clean piece of plate glass, which may be large enough to take one or several prints, should be dusted over with French chalk and then well polished with a dry soft duster. While the print is still in the washing water, place the polished glass under it, get the print into position, and then lift it out of the water. When the surplus water has run off, a piece of blotting-paper is placed on the print, and with the help of a roller squeegee the print is pressed into close contact with the glass. When thoroughly dry, the print will readily peel off the glass. Floating the print on to the glass under water ensures the absence of air bubbles. The prints will dry quickly in a current of hot air. The polished surface is not waterproof, but the print may be backed with waterproof paper, which should be pasted on the back of the print while it is still on the glass slab, so that the two may dry together. Photographs with a highly glazed surface are still in great demand among a certain section of the public; nevertheless, there is a growing preference for platinotype, bromide, and albumen prints. Enamelling is a process only suited to subjects requiring microscopic definition. It may be mentioned that it is now acknowledged by photographic experts generally that too much detail and too clear definition are not desirable in a portrait.

Various Methods of Bleaching Ivory.—Many methods of whitening yellowed ivory have been proposed from time to time, and the more reliable of them are given below in the order of their simplicity as near as possible. In a few cases the ivory is directed to be exposed to sunlight; this should be done always under glass, which prevents the formation of cracks. (1) Immerse the ivory in a very weak solution of sulphurous acid, and rinse in clean water. (2) Boil with a paste of burned pumice-stone and water; expose to sunlight. (3) Expose to the fumes of burning sulphur. The air should have free access to the ivory. (4) Immerse for one hour in a saturated solution of alum in water, rub with a woollen cloth, and wrap in linen to dry. (5) Immerse in water containing a very little chloride of lime, or in water impregnated with chlorine. (6) Place in a thin paste of lime and water. Gently heat, and when white remove, dry, and finally polish. (7) Brush with a solution of 1 oz. of nitric acid in 10 oz. of soft water. Rinse in clean water, and expose to sunlight. (8) Wash with soap and water, and place, whilst wet, in sunlight, continuing the washing two or three times a day until bleached. (9) Rub with fine pumice powder and water, and whilst still wet expose to sunlight. If unsuccessful, apply the pumice powder again. (10) Support the ivory a little above the bottom of a shallow glass vessel by strips of zinc, pour in spirit of turpentine, and expose to the sun for three days. (11) Remove grease by treating with a solution of common soda, and immerse the ivory in peroxide of hydrogen, to which liquid ammonia has been added in the proportion of 1 pt. of the former to 1 oz. of the latter. Gently heat for from twenty-four to thirty-six hours, remove, and dry slowly in the open air; rapid drying may split the ivory. (12) The Artus process is to place the ivory for two days in a solution of 23 oz. of carbonate of soda in 90 oz. of water contained in a glass or porcelain vessel. Well wash in pure water, and then immerse in a solution of 34 oz. of sulphite of soda in 91 oz. of water. In five or six days' time add to the solution a mixture of 2 oz. of hydrochloric acid and 11 oz. of water. Cover the vessel containing the ivory for from twenty-four to twenty-six hours, and then remove the bleached ivory, afterwards well washing it in clean water.

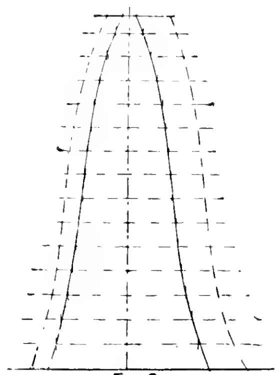


FIG. 2

Setting out Lead Bays for an Ogee Roof over a Ventilator Octagonal on Plan.

Lens for Photographic Portraiture.—A portrait lens is a lens so constructed as to give fair definition with a large aperture. Rapidity of working is the most important quality of a portrait lens, and to obtain this certain sacrifices have to be made. Sharp definition, which is generally undesirable, is obtained only at the expense of modelling. Roundness of field is a defect common to portrait lenses, but the newer and more expensive lenses are a vast improvement on the older and cheaper kinds. A good rectilinear lens is better than a bad portrait lens. A single lens, or one half of a rapid rectilinear lens, makes a good portrait lens, but it is slow.

Design for a Round Footstool.—Fig. 1 shows an elevation and Fig. 2 a plan looking from below of a footstool that is strong and has a good appearance. Any

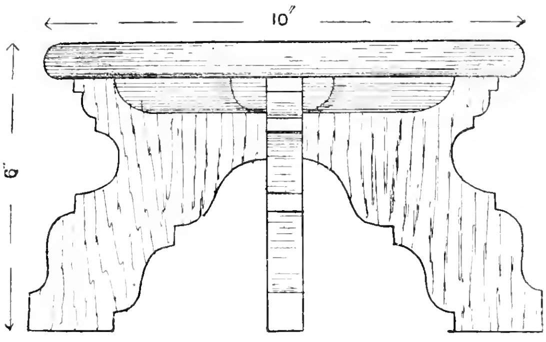


FIG. 1

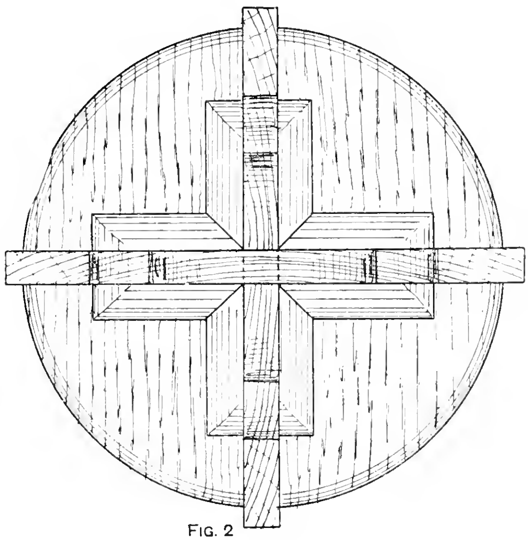


FIG. 2

Making a Round Footstool.

hard wood about ¾ in. thick is suitable for its construction. The quarter-round fillets form a good method of fixing the legs to the top.

How to Make Fly-papers.—Here is a recipe for making fly-papers. Add 4 oz. of syrup or treacle to 1 pt. of water, and boil with 1 dr. of white arsenic. Steep squares of moderately thick blotting-paper in the liquid and allow to dry. The papers are to be kept damp while in use. It need hardly be pointed out that white arsenic is a deadly poison.

Polishing Black Marble.—To polish black marble, the wrought surface is rubbed with fine sharp sand and water until all the marks of the chisel or saw are removed and an even face is produced; it is then grounded—that is, rubbed with grit stones of varying degrees of fineness, commencing with the coarse or first grit, next the second grit, which is a little finer, and finishing with snake stone or water-of-Ayr stone. Particular care must be taken in each process of gritting that the marks or scratches of its predecessor are removed, so that when the surface is "snaked" no scratches are visible. Then rub with a boss or pad of worsted material sprinkled with flour emery and moistened with water, and finally with a pad of felt sprinkled with putty powder (calcined tin). The chief factor in producing a good polish is persistent and attentive rubbing. An imperfect polish may be due to the slab not being properly grounded or gritted, which is the case if, on looking closely into the polish, small scratches are visible all over the surface; it must then be almost entirely repolished. If the polish is dull only, then the slab has not been sufficiently rubbed with the felt.

Replacing Broken Roof Slates.—To replace a broken slate, the nails that fix it to the batten must be broken or drawn by means of the slate ripper. The old pieces of

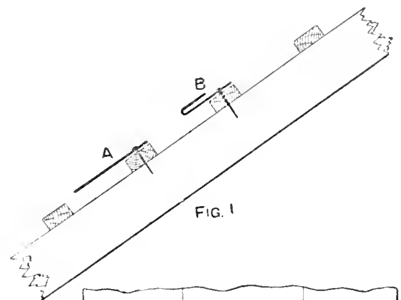


FIG. 1

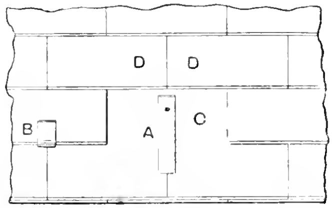


FIG. 2

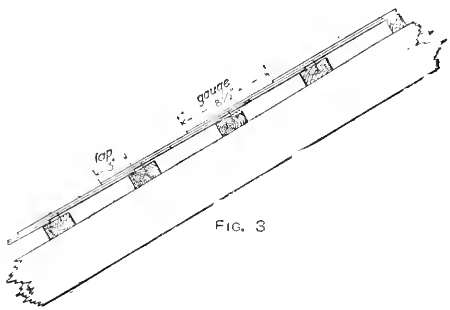


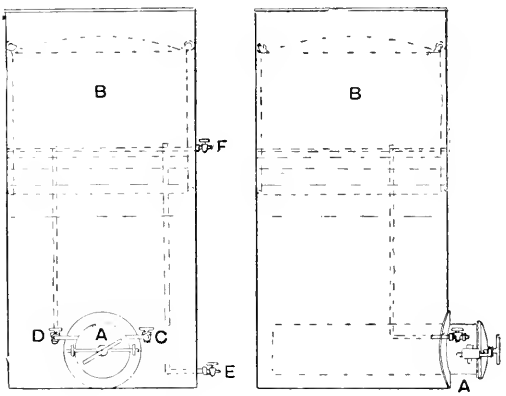
FIG. 3

Method of Replacing Broken Roof Slate.

slate will then easily slip out. A strip of lead about 8 in. long by 1½ in. wide must then be nailed to the batten that is near the bottom of the space to be covered by the new slate, and will be seen through the joint of the two slates immediately under, and then the new slate can be slipped upwards until it reaches the proper position, when the end of the lead strip can be bent upwards and will hold the slate in place. The strip of lead is fixed to batten as at A and turned up as at B, Figs. 1 and 2; C, Fig. 2, is the place the new slate has to fill, and the top end has to pass upwards under D D. Fig. 1 is a section and Fig. 2 a plan. Slates are fixed on to the battens by nailing with two copper or zinc nails, the former preferred. The slate immediately above the one that is nailed covers the nail heads, as shown by Fig. 3.

Removing Cores from Antelope Horns.—To remove the cores from a pair of antelope's horns, place the horns in a warm, moist place, say inside a hot manure heap, until the connecting tissues between the horns and the bony cores become sufficiently decomposed to enable the horns to be pulled off.

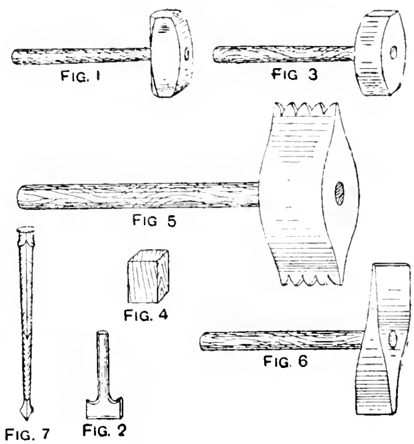
Acetylene Gas Generator.—The various patented apparatus for making acetylene gas from carbide of calcium have generally had the idea of working automatically, so that as the gas is consumed a fresh supply is made, and the plant thus made continuous. The two methods generally adopted are either that the carbide shall be added to the water or, what is perhaps better, the water added to the carbide. Carbide, however, has such a great affinity for water that it will take it from any source, and consequently the manufacture of the gas often goes on long after the gasholders are full. The chemical action is expressed by the following formula. $CaC_2 + H_2O = C_2H_2 + CaO$, showing that when carbide of calcium (CaC_2) and water (H_2O) are mixed the result is acetylene (C_2H_2) and lime (CaO). One pound of calcium carbide will make 5 cub. ft. of gas. The safest method of making an acetylene gas generator is to follow the lines of a coal-gas making plant, and to have a gasholder large enough for the daily consumption, and to introduce so much fresh carbide as will serve just to fill the gasholder each day. The apparatus is very simple to make. It should consist of a rather deep sheet-iron tank, so that both the gasholder and the retort may be inserted in it, while the former may be allowed to travel up and down inside the upper portion of the tank, which will thus form guides for keeping the gasholder vertical. As carbide gives off a considerable amount of heat when acetylene is being formed, and as this is likely to prove dangerous it is best to have the retort, and the pipe from it to the gasholder, under water. Such an arrangement is shown in the sketch. The retort A is best made of cast-



Acetylene Gas Generator.

iron, with a flange for fastening to the sheet-iron tank, and a lid to be fixed on by a cross bar fitting into two ears or lugs on the sides of the retort. The pipe C for supplying water to the retort is brought out from the tank, and a cock F fitted so that it can be shut off. The supply-pipe D to the gasholder B is arranged in like manner, so that when recharging the retort the cock can be closed and the gas in the gasholder preserved. E shows the gas outlet pipe. The water in the gasholder tank will absorb a large quantity of acetylene gas until saturated. Acetylene has approximately fifteen times the lighting value of common gas, but only two and a half times the heating value, so that it is not advisable to use it for cooking or heating purposes where cost is a consideration. Acetylene gas destroys iron burners by enlarging the holes, etc. On most burners, after being in use a short time, a soot is deposited; this should be removed by a tooth or other brush. The usual burners consume ½ to ¾ cub. ft. per hour.

Granite-working Tools.—The granite-working tools used in Cornwall and in Devonshire are as under. Fig. 1 shows a hand hammer; its shape varies, but it should be stiff near the eye, as there is then less risk of its splitting when driving plugs. Its weight is usually from 1½ lb. to 5 lb. It is made of solid cast steel, the hammer being about 5 in. long and the handle about 9 in. long. Its chief use is thus explained: When a rough block of stone comes from the quarry, the mason gets his mould for the bed, marks its shape on the bed, and if there is only about 1 in. or 1½ in. of waste stone, he takes the pitching tool (Fig. 2) and hand hammer and pitches it off. If, however, the waste stone is in greater quantity, he removes the excess with the spall hammer (Fig. 3). The spall hammer weighs from 18 lb. to 24 lb., and is used for hammering rough stones into shape. Next the mason takes a chisel that is made of best silver steel, is octagon or oval in shape, and is 8 in. long (size when new), with 1 in. at the flat end. A peg-mark is then chiselled at each of the corners. Four hardwood bossing pegs (Fig. 4), 1¼ in. long or more, and made true, are then put one at each corner. A line is then put round and the drafts are marked, then the punch, 10 in. long and made of 1⅛-in. steel either octagonal or oval in shape, is used for removing all superfluous stone. Next the mason takes a slad axe or chopping axe, the blade of which is about 7½ in. by 2½ in., and the handle about 16 in. long, and chops all round the drafts, keeping the axe in front of him. The patent axe is then used. A four-bladed axe is used for the roughest patent-axe work; a six-bladed axe is generally used for ordinary work. The box of this axe is in two parts, and there are four bolt holes in each for screwing it up when the blades are put in. The blades are from 2½ in. wide, and the handle about 16 in. long. After being sharpened on a grinding stone, they are tempered and screwed in the box. When once tempered by a good smith, they will stand three or four grindings before being tempered again. A patent axe may be four-cut, six-cut, eight-cut, or ten-cut. It is not often above ten-cut. After single-axing the bed of the stone, take the six-cut and axe all round. If eight-cut work is specified, take the eight-cut axe over the six-cut work, as this leaves it fine for the edges or arris. Next take the chopping axe and chop down all the knots or knobs left from the punch.

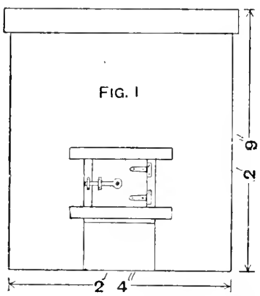


Granite-working Tools

When a nobbling pick is used, as it still is in Cornwall, a stone can be left a little rougher from the punch; then, nobbled down, it comes easier for the tooth axe, as very few granite masons punch fine enough for a tooth axe. A nobbling pick is a pick that, being worn down to 7 lb. or 8 lb., is no longer used for scappling. A scappling pick, which is of the same shape as that shown in Fig. 6, weighs, when new, from 12 lb. to 18 lb. It is of solid cast-steel, and is used when there is rather too much for punching and not enough for the plug and feathers. A nobbling pick is very useful for tooth-axed work, to which it gives a clean appearance. Good slad axes and tooth axes may be made from short picks, but there must be no flaws in the pick. The handle of the nobbling pick is about 18 in. long. After the face has been nobbled, a tooth axe, as illustrated, is used. For work left after this tool, called tooth-axed face, the axe is about 4 in. wide, and the handle about 16 in. long (see Fig. 5). Fig. 6 shows a cross axe, the handle of which is about 11 in. long, for axing hollows or scotias in mouldings. A patent or bush chisel, with four or five blades, is used for axing mouldings or places inaccessible to the bush hammer. The complete chisel is about 10 in. long, and the blades are about 1½ in. wide, and are bolted in with one bolt in a groove into which the blades fit. In use it is struck lightly on the head with a hand hammer. The muckle (large) hammer is for chasing or making a channel when splitting up the granite. The hand-drill for boring holes to split the granite has a ¾-in. bit, and is made all in one piece of solid cast-steel (see Fig. 7). It is held in one hand and struck with the hand hammer, turning alternately, to a depth of 3-in. holes about 4 in. apart. Then the feathers and plug are put in, the round side of the feathers facing in the hole the way it is to be cut; then the plug is driven in until the granite splits. The plug and feathers are each about 4 in. long.

"Rotted" Brass.—Brass in course of time undergoes a molecular change which renders the alloy very brittle, and this action sometimes causes cracks to open in the metal, particularly if it is subject to variations of temperature when moisture is present. Brass wire when subject to tension rapidly loses its working properties. In either of the above cases the alloy is known as "rotted" brass, and may be distinguished from new-made brass by bending it sharply to an acute angle; if signs of partial fracture are quite absent, the metal may be used.

Flash-flue Washing Copper.—Compared with the flash-flue copper, the wheel-flue is a primitive and costly arrangement. It is much less easily heated, and therefore requires more coal than a flash-flue copper, and, moreover, it cannot be cleaned out without taking the brickwork down to get at the flue. Herewith are illustrations of a flash-flue copper. In building the copper, set the door-frame on the second course of bricks and proceed as indicated in the illustrations. Set the slab plate next to the door-frame, 4 in. wide, and bars 12 in. long by 9 in. wide will be quite large enough for a boiler of this size, which will boil in half an hour, with much less coal than a wheel-flue, which would take two hours to boil. When flash-flue coppers get choked up at the bottom of the chimney, it is only necessary to lift out the copper, clean it out, replace it, and point round the top with a little lime putty; the copper is then ready for use again. A 6 in. sanitary pipe makes a good and cheap chimney for this size of boiler furnace. It is best to cut either a stone or a firebrick quarrel to fit round the top of the copper, which makes a little projection, and sets the work off a little. The illustrations represent, respectively, Fig. 1, front elevation; Fig. 2, plan; Fig. 3, transverse section; Fig. 4, longitudinal section.



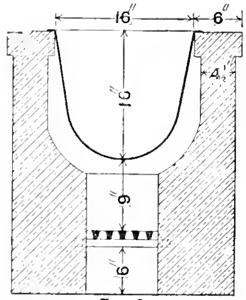


FIG. 3

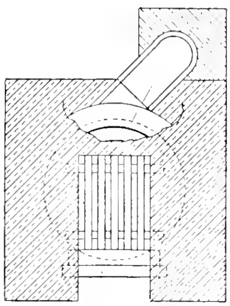


FIG. 2

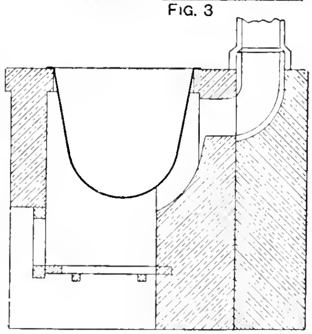
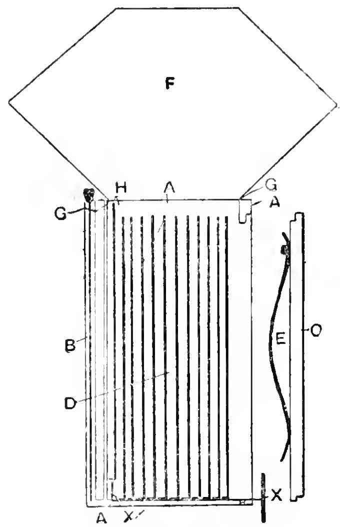


FIG. 4

Flash-flue Washing Copper.

Renewing Washers in Cold-water Taps.—The first thing to do when renewing the washers of water taps is to shut off the service pipe leading to the tap. If the pipe is from a house cistern, then the stop-cock must be closed. If there is no stop-cock, the hole in the cistern must be plugged with the pointed end of a broom-handle. If the cock to be repaired communicates directly with the main, then the main cock in the cellar, if there is one, must be closed, or the water company's cock in the pavement. Having cut off the water from the main, unscrew the upper part, the middle stem, of the cock with a spanner. Sometimes a small ordinary screw will be found in the edge of the shoulder part; this must be unscrewed with a screw-driver and removed first. When the stem portion of the tap has been removed, the small part that has the worn-out washer on it will either come away with, or will be found loose in, the body of the cock, and can be lifted out with the fingers. This part is frequently called the "jumper," and to this the washer is secured by a small screw collar, which is easily removed with a screwdriver. When the old washer is removed and the new one is slipped on, this screw collar is replaced; it merely holds the washer on. The jumper and other parts are then replaced in their order. Washers of red rubber are more lasting than ordinary white or gray washers.

Constructing Magazine Back for Camera. The bag changing box is the most satisfactory form of a magazine back to hold twelve quarter-plates in sheaths. This changing box consists of a box A with grooves at the front B to take a sliding shutter after the manner of a dark slide. The back C is removable to allow of the insertion of the block of sheaths D, and to it is fixed a spring E that forces the sheaths together. A bag F is fastened to G G; this bag is made of flexible material, and is of the shape shown. When the box is fixed in the slide rails of the camera, the shutter is drawn and the front plate is exposed. The plate is changed by gripping, with the thumb and forefinger, the top of the sheath H through the bag, withdrawing the sheath gently and pushing it in at the back. The next plate in the sheath is thus forced forward. A lever X is provided to lift the front plate.

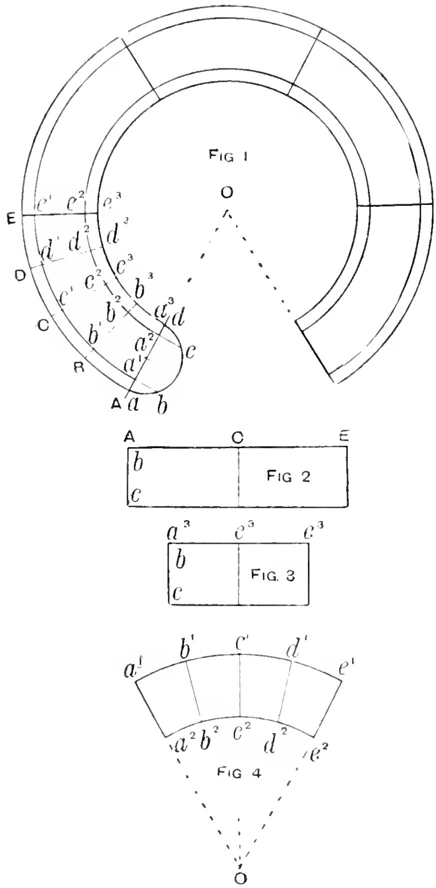


Constructing Magazine Back for Camera.

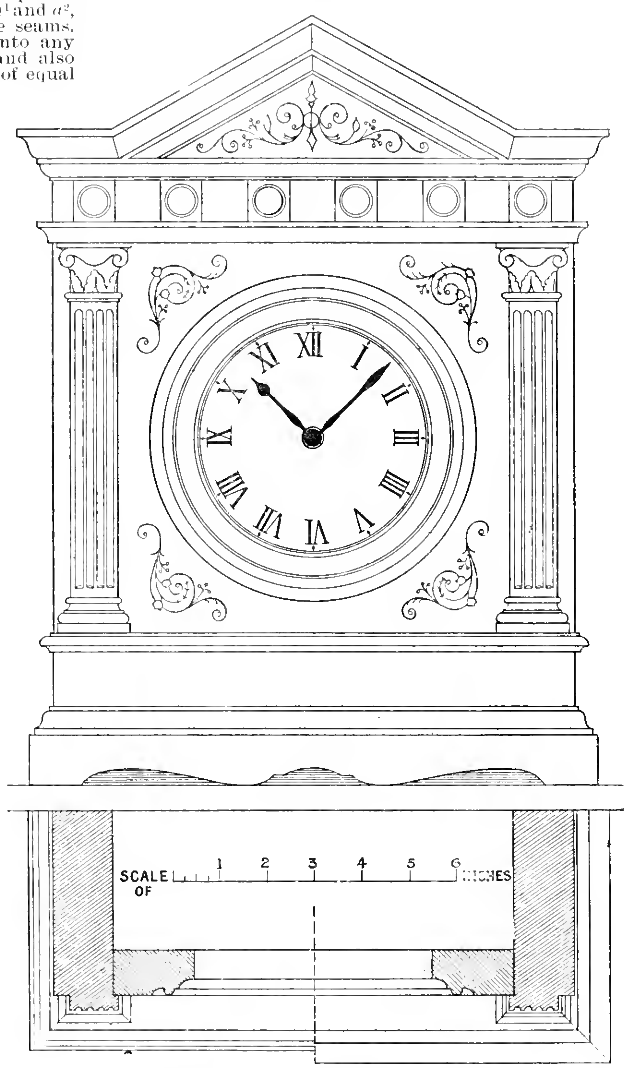
Straightening Watch Hairsprings.—The straightening of a hairspring is a difficult and tedious job. First unpin the spring from its stud and place it on a watch glass upon a sheet of white paper. Then with two pairs of fine-pointed tweezers, one pair in each hand, proceed to re-shape the faulty coils. Begin at the centre of the spring, and follow it round with the eye until the exact point of the first departure from trueness can be noted. Rectify this and proceed, always working from the centre to the outer coils. First get the coils concentric, true, and at equal distances from each other. Then proceed to get the spring flat, working as before from the centre to the outside. To act properly a hairspring must be flat, true in the "eye," and all the coils must be free of each other and at an equal distance. The outer coil should pass freely between the curb pins and, when the balance is at rest, should not touch either curb pin.

Joining Rubber to Canvas.—In joining strips of rubber to new canvas the latter is liable to soak up much of the rubber solution. The only satisfactory way of preventing this is to treat the rubber with the solution (made as on p. 52) and, when the latter is "tacky," to press the strip on the canvas. The canvas would be rendered harsh and stiff if it were treated with anything to prevent the rubber solution soaking in.

Patterns for Tuyère Bend.—The tuyère bend, of which Fig. 1 is a plan, is to be made in five segments, joined together with angle iron, each segment being made with four plates ¼ in. thick. To obtain the pattern, first draw a plan of the bend, as Fig. 1, and then the semicircle $a\ d$ on the end of the figure as shown. As the segments of the bend are to be each made in four pieces, the position of the seams may be fixed by making $a\ b$ and $c\ d$ each equal to one-fourth of the end semicircle. Draw lines at right angles to A a^3 from the division points $b\ c$ to give the points a^1 and a^2; then, using O as centre and radius to a^1 and a^2, draw arcs of circles to show the position of the seams. Now divide the outer curve of one segment into any number of equal parts, as A, B, C, D, and E, and also divide the inner curve into a similar number of equal divisions; then join the points on the inner curve to the points on the outer curve, as A a^3, B b^3, etc. To work the pattern for the outside section of the bend, make the straight line A C E (Fig. 2) equal in length to the outer curve of the bend. From points A and E (Fig. 2) drop perpendicular lines, and make them equal in length to the arc of a circle $b\ c$ (Fig. 1). Draw a line from c (Fig. 2) parallel to A E to form the rectangle for the pattern (Fig. 3). The pattern for the inside section of the bend is worked in the same manner, $a^3 c^3 e^3$ (Fig. 3) being equal in length to the inner curve (Fig. 1), and $b\ c$ (Fig. 3) being equal to $b\ c$ (Fig. 2); the rectangle is formed complete by the same method of working. For the side pattern, take O a^2 (**Fig. 1**) as radius and draw an arc of a circle O a^2 e^2 (Fig. 4). Make a^2 e^2 equal in length to the curve a^2 e^2 (Fig. 1), and then mark off on the curve the divisions a^2, b^2, etc. (Fig. 4), transferring these from Fig. 1. Through O c^2 (Fig. 4) draw the line $c^2 c^1$ on the pattern, and make the length from c^2 to c^1 equal to $b\ c$ (Fig. 2), or equal to one-fourth of the circumference of the end of the bend. Using this length as radius, and a^2, b^2, d^2, e^2 (Fig. 4) alternately as centres, draw arcs of circles at the top of the figure. Now with $a^1 b^1$ (Fig. 1) as radius, and using c^1 (Fig. 4) as centre, draw arcs of circles to cut those already drawn, and to give the points b^1, d^1 (Fig. 4). With the same length as radius, and b^1, d^1 as centres, cut the two remaining arcs to give the points a^1, e^1. Join a^1 a^2 and e^1 e^2 by straight lines, and then draw a curve to pass through the points a^1, b^1, c^1, d^1, and e^1, to complete the pattern.



Patterns for Tuyère Bend.



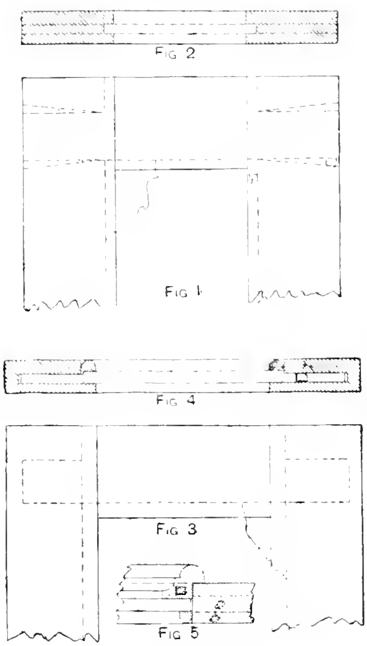
Design for a Marble Clock Case.

Design for a Marble Clock Case.—The accompanying illustrations show a design for a clock case. The upper is a front elevation showing the clock itself in position, whilst the lower is a section. If the design is not wide enough, an additional pilaster on each side may be added. The ornament in spandrils and tympanum should be incised and gilt.

Hollowing Iron Cones.—Sheet metal cones are usually hollowed before the seams are formed, by working along the curves forming the top and bottom parts of the pattern, and then in to the centre, with a block hammer used on a beech block with holes cut in the end of a depth suitable to the curve of the work. If the cones are to be of galvanised iron, the zinc scales would continually peel off the iron during the hollowing operation, so it would be advisable first to make the cones of black iron, and then to have them galvanised.

Ring Weights on Safety Valve.—The recognised method of deciding on the number of ring weights required to balance a certain pressure in a dead-weight safety valve, the latter being fixed, is to put all the rings on and, when the water is in the apparatus, to lift one or more rings off until the valve just leaks; then put back again the ring last removed to stop the leak. Some people, after putting a ring back to stop the leaking, put one more on, to make sure. The rings generally represent a pressure of about 1 lb. to 6 lb. per square inch, but this depends on the weight of the ring and the area of the aperture it closes. A 1-lb. ring bearing on an aperture of 1 sq. in. area would represent 1 lb. per square inch, and the pressure is increased by making the ring heavier and the hole smaller.

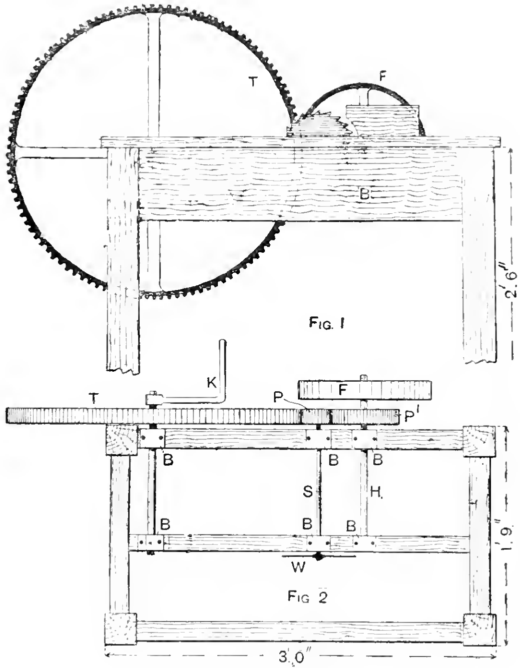
Construction of Small Panelled Doors.—Joiners and cabinet makers have different methods of constructing small doors. Fig. 1 shows part of the elevation of a plain one-panel door, as made usually by the joiner. Fig. 2 shows the ends with the stiles in section, the dotted lines indicating, as in Fig. 1, the positions of the panel and tenons. It will be seen that the panel is in grooves worked on the inner edge of each piece of wood forming the frame, and that, once together, the panel is fixed so that it cannot be removed. Figs. 3 and 4 show the cabinet-maker's method; movable panels are used, the inner and back angle of each piece of wood forming the door being rebated. The panel can then be removed by unfixing the beads shown in Fig. 4. It is obvious from this that the advantage of this construction is considerable in French-polished articles. In cases where a raised or bolection moulding is used, as in Fig. 5, no rebate is necessary. The mortises and tenons of cabinet work are rarely cut through, as less exposure to damp renders this less needful, and a better appearance is secured when the ends of tenons are not visible.



Construction of Small Panelled Doors.

Curing a Rabbit Skin.—To cure a rabbit skin, it must be fresh flayed and cleaned of all fat and particles of flesh by scraping it with a blunt knife whilst stretched, fur inwards, upon a rounded surface such as a baluster rail. Then steep it in a solution made by mixing thoroughly together when dry 4 parts alum and 1 part common salt, and then adding as much warm water as will dissolve the mixture. The quantity depends on the size of the skin. To ascertain when it has soaked long enough, squeeze the liquid from it. Then double it, with the skin side outwards, so as to make a crease, and when the line shows white the soaking can be stopped. The soaking usually takes about forty-eight hours. Make a paste of flour and water, and, having rinsed the skin, dip it for a minute in the warm gruel. Then wash it clean with cold water, and dry it. When about half dry, stretch again on a board, and rub with pumice. Small skins, when freshly flayed, can be cured by being soaked for a few days in a solution of tan. This can be made by boiling oak bark or oak galls in rain or distilled water, or by dissolving tannin in soft water. Fill a pot with oak bark, and boil it in twice as much water for three hours. Use the solution cold, and take out and rub the skin as often as possible during the process.

Circular Saw Bench.—The accompanying illustrations show a bench with a small circular saw driven by means of two toothed wheels turned with a hook-handle. In addition to the toothed wheels, a shaft carrying a flywheel F (Fig. 1) is shown. The momentum of this wheel will greatly assist in the turning of the handle. As the saw cannot be driven at a very high speed, the feed speed must necessarily be slow; a saw up to 8 in. in diameter will be quite large enough for such limited power. A higher speed could be obtained by having a greater number of toothed wheels and arranging them differently, but this would mean a loss of power. In Fig. 2, which is a plan of the frame of the bench, wheels, etc., in position, T is the large toothed wheel, 2 ft. 6 in. in diameter, geared in a pinion P, 2 in. diameter, which is keyed to the saw spindle S. This pinion gears in another pinion, or small toothed wheel P′, 4½ in. in diameter, on the flywheel shaft H. On the end of this shaft the flywheel F, 1 ft. 3 in. diameter, is keyed. This wheel should have a fairly heavy rim. W is the saw, and B the bearings in which the saw spindle and wheel shafts run. The hook handle K is secured to the end of the shaft that carries the large toothed wheel. Fig. 1 is a side elevation of the bench complete; B is the bench, which may be about 2 ft. 6 in. from floor to table, and T is the large toothed wheel. The speed of pinion P will be fifteen times the speed of the large toothed wheel T.



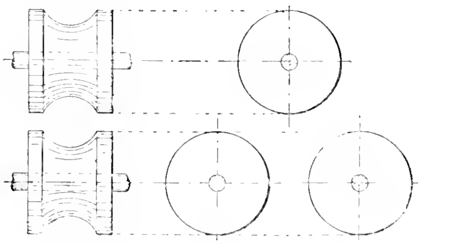
Circular Saw Bench.

Re-pointing the Pivots of a Drum Clock Balance.—In sharpening the pivots of a drum clock balance, hold the axis of the balance by one end in a pin-vice and sharpen the centre of the other end on an oilstone, at the same time revolving the pin-vice rapidly in the fingers with a twirling motion. This will keep them circular and prevent flats being formed. Watch and clock drills are also held in a pin-vice for sharpening and carefully rubbed on the oilstone. An inspection of a new drill will show the correct shape and angle for the cutting edges.

Felt Hat Reviver.—The best material for cleaning felt hats of any colour is re-distilled benzine. After well rubbing this into the hat, give it a good brushing to remove the dirt; grease-spots should be well rubbed with a rag dipped in the liquid. For grey hats, mix a little light magnesia with the liquid and brush out the powder after drying.

Applying Asbestos Paste.—In applying asbestos paste to a boiler shell, hot-water pipes, steam pipes, etc., first rub some of the paste on the surfaces with the hand or with a piece of cloth or canvas, leaving it quite rough so as to form a key for that which follows. The first coat is rubbed on to ensure the whole having actual contact and holding securely to the boiler. When the paste is dry, with a trowel apply the remainder in about ½-in. layers, leaving the surfaces rough (except the final one), and letting each coat dry before applying the next. The surfaces treated should be quite hot whilst the paste is being applied with the trowel; the heat slightly opens the pores in the metal, and this prevents cracking or shelling afterwards.

Machine for Bending Brass Tubes.—A bending machine for brass tubes consists of three small rollers, which work simultaneously and are adjustable; they are in the form of a triangle, as shown in the illustration. The tube is passed between the rollers and is bent round in a circular manner, and according to the adjustment of the rollers so is the radius of the circle altered. Each separate size of tube requires separate rollers. Very thin tubes will require first to be loaded with sand before passing them through the machine, otherwise the walls of the tubes will buckle and so spoil the work.

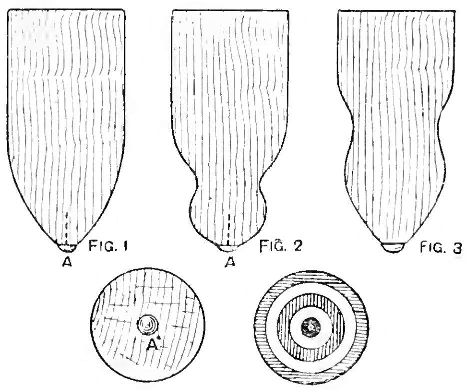


Machine for Bending Brass Tubes.

The same machine framing will take any number of different sized rollers.

The Manufacture of Kid Gloves.—Ladies' kid gloves are made from skins taken from a five-weeks-old kid, whilst gentlemen's gloves are made from a stronger skin coming from a two-months-old animal. Among the glove leathers in general use are (1) glacé kid, a polished material coloured on the grain or hair side; (2) undressed kid, coloured on the flesh side; and (3) castor kid, coloured on either or both sides after the grain has been scraped off. From twenty to twenty-four complete pairs of gloves can be made up from one dozen skins, the actual number depending, of course, on the size of the gloves; ladies' gloves range in size from 5½ in. to 7½ in. round the palm of the hand, gentlemen's from 6¾ in. to 10 in., and girls' from 4½ in. to 6½ in. In making gloves, the first operation is the shaving of the dressed skin, which is damped and laid out flat, grain side down, on a marble slab whilst a knife or shaver is made to thin down the skin to the proper thickness; to prevent the knife slipping, flour is sprinkled on the skin. After being stretched, the skins are cut by hand into glove parts of the desired size, and then are riddelled—that is, lines showing the shape of the fingers are made with a stamp, each size having a different stamp. The thumb pieces are marked in a similar manner. The spaces between the stamped lines are about double the width of the fingers, so that when the leather is stretched over the tough cardboard pattern, the lines may be drawn more closely together. The glove patterns are from 10¼ in. to 11½ in. long, and from 4½ in. to 5¼ in. wide. A separate pattern for the thumb and fourchettes is required (the fourchettes are the pieces between the fingers). A pattern is placed on a table, the marked-out end of the piece of leather is laid on the finger end of the pattern, and the leather is stretched by hand until the spaces between the lines are of the same width as the fingers on the pattern beneath; then the thumb and fourchette pieces are done in the same way. After a close inspection the glove parts are taken to the cutting presses, in which are movable steel dies encircled by sharp steel knives; six thicknesses of glove leather are placed over the die, then a strip of paper, and then a piece of rubber. By pulling a lever, an iron plate is forced down on the rubber disc, the leather being forced over the knife edges and cut as required. The thumb pieces are cut in a similar manner, and then the backs of the gloves are embroidered by machine. Fourchettes of suitable size are selected and cut, two at a time, to the desired shape by a die. In sewing together the gloves with an over-seam stitch, the piece between the thumb is sewed on first, then the thumb, and then the fourchettes, and so on. A narrow strip of binding is sewn on the inside to keep the leather from tearing where the hooks or buttons are placed. Sharp-pointed pincers are used to bring the parts together for sewing, and the glove is held in position by means of two circular pressers which revolve when the sewing machine is at work and cause the glove to move forward during the sewing operation. The sewn gloves are placed in a damp cloth for about ten minutes and then flattened and pulled into shape by hand rubbing on a smooth table; sometimes a wooden roller is used to flatten them. Black gloves are given a lustre by being rubbed by hand with a mixture of neat's-foot oil, soap, vaseline, and grease. To polish glacé kid gloves, they are distended on a piece of cardboard and pressed against a plush-covered wheel about 12 in. in diameter making 350 revolutions per minute. The gloves are then ready for the buttons, clasps, etc.

Making a French Whip-top.—To make the simple wooden top here illustrated, all that is required is a



A French Whip-top.

piece of round wood about 2½ in. long and about 1¾ in. in diameter; a piece of a stout broomstick will answer the purpose very well. It should be cut or turned to one of the shapes shown by Figs. 1, 2, and 3, and a small brass-headed nail driven in at the bottom as shown at A in Figs. 1, 2, 3, and 4. The top may be roughly ornamented with bands of colour as shown in Fig. 5. This gives a pretty effect whilst the top is spinning. The body of the top is usually stained black. The lash of the whips used to spin these tops is generally a strip of dried eel-skin, but a piece of tape tied to a stick answers the same purpose.

Cleaning Animal's Skull.—The simplest method of skeletonising an animal's skull is to boil the skull until all the flesh can be easily removed with pieces of blunt wood; but steaming the skull would be better if it could be arranged; these methods are liable to make the bones very greasy-looking. Another method, though very disgusting, is to macerate the skull in cold water, and, when the flesh has putrefied, to scrape and scrub the bones until clean. The whole can then be whitened by soaking for about six hours in 1 gal. of water to which has been added 2 oz. or 3 oz. of chloride of lime. The skull may be soaked in water until the flesh and fibres are soft enough to be scraped off. Special bone-scrapers are used by professional osteologists, but for a single specimen a penknife would suffice. The dirt can be removed by well scrubbing with plenty of soap and soda, combined with the scraping; and if, after soaking in the chloride of lime solution, the result is not satisfactory, wet the skull every morning and evening, and leave it exposed to the sun and wind until bleached. Two things should be remembered—every particle of flesh, skin, etc., must be removed; also, the scraping, having been commenced, must be finished, or the skull placed back in the water.

Design for a Small Tracery Window.—Figs. 1 and 2 are the plan and elevation of a small two-light window in the Decorated style (1300-1400), with a tracery head. The size of the sill is 12 in. by 9 in.; it is weathered and stooled, and also holed to receive two saddle bars. These are of ⅝-in. wrought-iron, finished with trefoiled heads as shown, and there are also to each window three

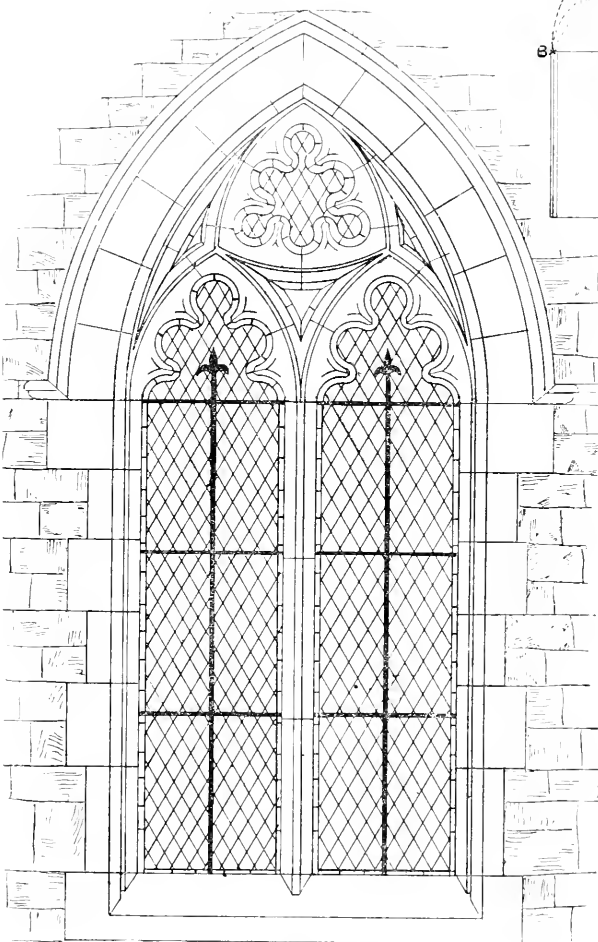


FIG 2

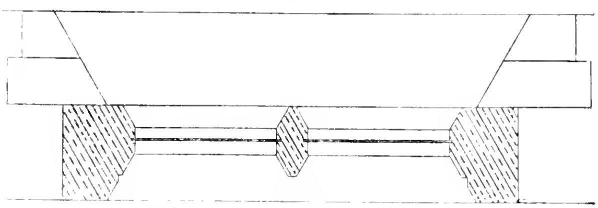


FIG 1

Design for Small Tracery Window.

horizontal bars, all of uniform size. The jamb stones, averaged, are 12 in. by 9 in., splayed and sunk as on plan, and the splayed mullion dividing the two lights is 9 in. by 4 in. The radiating arch stones are of the same section as the jamb stones, but are rebated to receive the tracery head. A 3-in. moulded hood with returned ends is turned over the arch as shown. Fig. 3 shows the method of obtaining the centres and centre lines for the tracery head by means of an equilateral triangle; A A A A show the centres for the tracery, and B C the centres for the window arch.

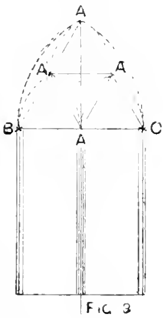


FIG. 3

Double Sashes for Deadening Noise.—A window sash frame with a double pair of sashes is employed often for deadening outside noise. The accompanying illustrations show such sashes and frames, Fig. 1 being a vertical section and Fig. 2 part of a horizontal section.

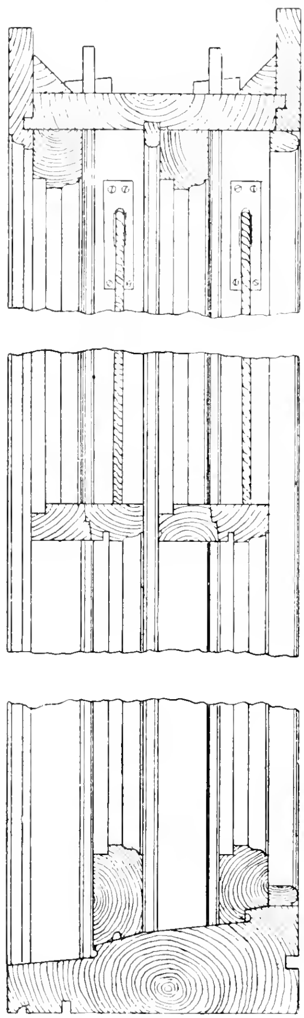


FIG 1

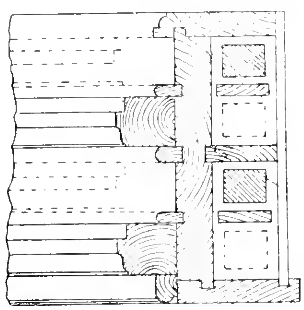
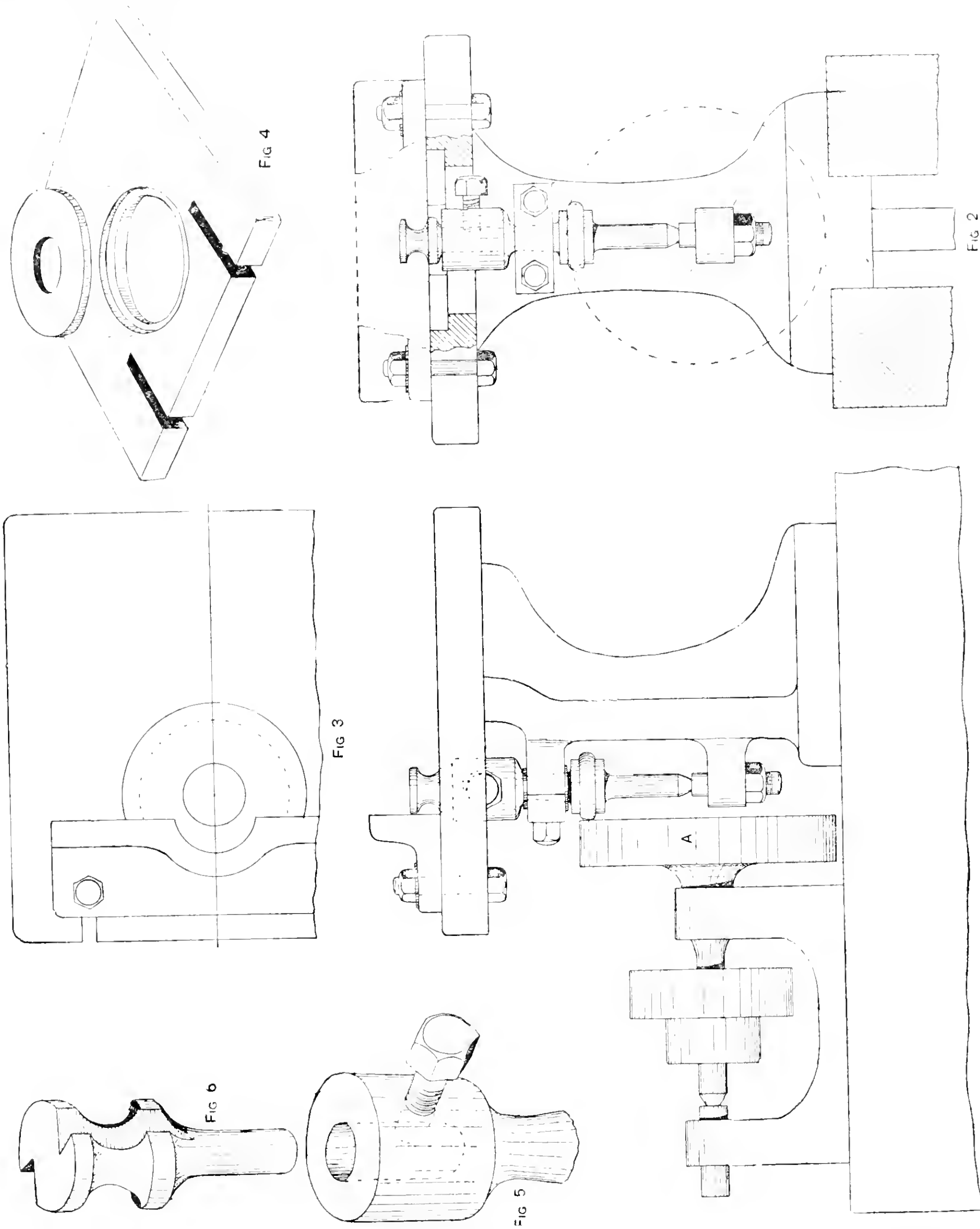


FIG 2

Double Sashes for Deadening Noise.

Blackening Nickel.—The best methods of blackening nickel are the first and third given on p. 55 for blackening brass. Nickel may be blackened by placing for a sufficiently long time in sulphuretted hydrogen gas.

Beading Spindle for Lathe.—The accompanying illustrations show the construction of a beading spindle for a woodworking lathe. The table standard with bearings can be one casting as shown, and made to fix to the lathe bed in the same manner as the rest or headstock. A hardwood disc must be turned and secured to the mandril of the fixed headstock as shown at A (Fig. 1). The beading spindle must be provided with a grooved pulley, into which an indiarubber ring must be fixed and pressed firmly to the disc A as indicated. Fig. 2 is a side view of the table standard as fixed to the lathe bed. Fig. 3 is a part plan of the table and fence. Fig. 4 shows the top with movable disc, and slotted for set-screws for the fence. Fig. 5 shows the top part of the spindle; and Fig. 6 one form of solid cutter for beading. The size can be varied to suit circumstances.



Beading Spindle for Lathe.

Wax Filling for Engraved Plates.—The following are methods of filling engraved plates. (1) Fill up the cuts with finely powdered sealing-wax of the colour required, press down, and see that but little of the wax is left on the surface of the plate. Warm the plate gradually until the wax is melted, and put aside to cool. Then finish with a Tam-o'-Shanter stone to remove any wax left on the surface of the plate, and polish with oil and flannel. (2) Some engravers prefer grinding the sealing-wax in gold size, and, when the plate is filled in and set, polishing with alcohol. (3) Dissolve sufficient black or red sealing-wax in alcohol to make a thick paste, and fill the engraved lines. When the alcohol is evaporated the wax becomes hard

Preparing Watch Plates for Gilding.—Watch plates are prepared for gilding in the following manner. After being rubbed smooth with water-of-Ayr stone, the plates are immersed for a second or two in a mixture of 4 parts of hydrochloric acid and 5 parts of nitric acid, both at full strength. They are then thoroughly rinsed and scratch-brushed, after which they are ready for gilding. Sometimes the plates are heated before dipping them in the gold solution; this softens them, but enables a good colour to be got with a very little gold.

Trestles for Tea-tables.—Figs. 1, 2, and 3 show a tea-table trestle with four legs, and Figs. 4, 5, and 6 one with three legs. Fig. 7 shows the joint most suitable for connecting the legs to the top beam. These joints may be fastened with nails, but a stronger method is to glue and screw them together. The leading dimensions and sizes suitable for ordinary purposes are shown; these, of course, may be varied to suit circumstances.

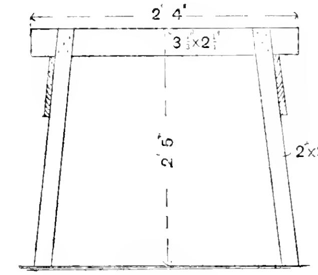


Fig. 1

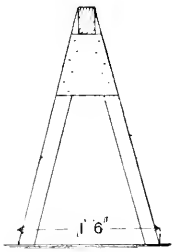


Fig. 2

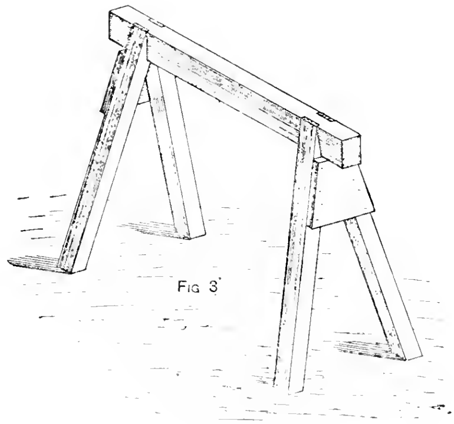


Fig. 3

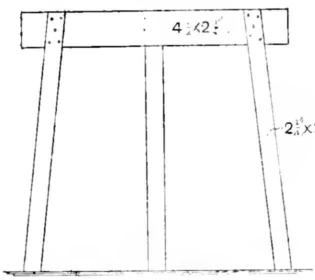


Fig. 4

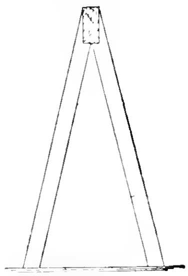


Fig. 5

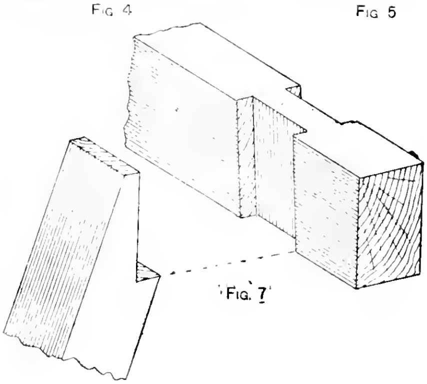


Fig. 7

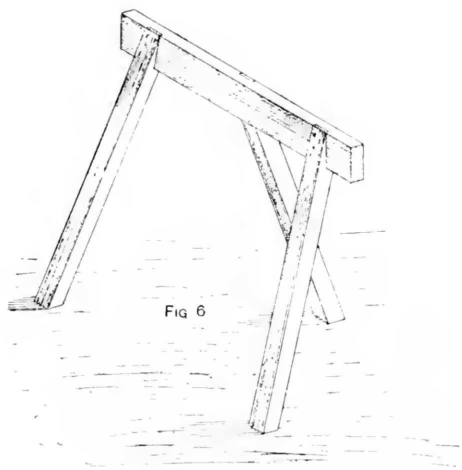


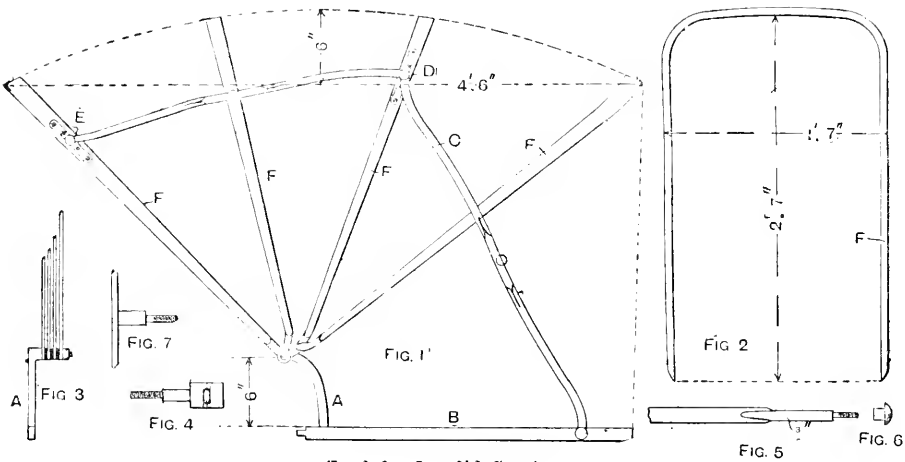
Fig. 6

Trestles for Tea-tables.

Fresco Painting.—There are two kinds of fresco painting—that done when the plaster is wet is called fresco buono; that done after the plaster is dry is called fresco secco. Dampness in the basis is fatal to fresco work. Free-stone is a bad basis, and rubble is worse. Brick is perhaps the best, and the brickwork must be perfectly dry before the first coat of plaster is applied. The first coat consists of 2 parts of clean sharp sand, carefully washed to free it from all impurities, mixed with 1 part of best old lime. To prepare the lime, mix it in a trough to the consistency of cream; then pass it through hair sieves into jars, where it must be allowed to settle, the water being poured off. The second coat, or intonaco, is composed of finer materials than are contained in the first coat; the second coat is floated on in two coats, and is properly finished till the surface is true and of an even grain. If the picture is a large one, only as much of the wall's surface as can be covered in a day's work is prepared. While the surface of the wall is still wet, but firm, a cartoon or tracing of the proposed design is laid over the prepared portion of the wall, and the lines of the picture are lightly indented on the wall with a blunt bone or hardwood point. When the intonaco is firm enough to bear the pressure of the finger, the colour is put on. To hide the joinings between each day's work, the painting is as far as possible suspended at the folds of drapery or in the shadows. The painting must be done quickly, and mistakes can only be rectified by cutting out the defective piece and applying fresh plaster. The colours for fresco work are ground and mixed with water, but only those colours capable of withstanding the action of lime must be used. The following are a few of the suitable colours: Vermilion, Venetian red, Indian red, burnt sienna, aureolin, yellow ochre, terre verte, French blue, ultramarine, cobalt, burnt umber, Verona brown, Vandyke brown, Caledonian brown, raw umber, raw sienna, ivory black, lampblack. It must not be forgotten that the colours dry much lighter than they appear when freshly laid on the wall; the art of mixing the colours, therefore, so as to obtain the desired tone in the finished work can be acquired only by experience. In executing fresco secco the wall is damped before the colours are laid on. It is, of course, a less tedious and less troublesome process than fresco buono, but the result is considered to be inferior.

Making Logwood Extract.—Extract of logwood is made by grinding logwood under corrugated rolls to reduce it to a coarse powder; the latter is then boiled with water under pressure to extract the whole of the soluble ingredients. The solution thus made is then evaporated to dryness in shallow or vacuum steam-heated pans, and forms the dry extract. Logwood chips instead of the extract may be used for many purposes.

Hood for Invalid Carriage.—The method of fixing a hood on an invalid carriage will depend on the shape and size of the body of the latter. Fig. 1 shows a four-stick head made on a cod iron A (Figs. 1 and 3), welded into a frame B (Fig. 1) made of 1-in. by ¼-in. flat iron. This frame goes round the body, being shouldered down at the front end to slip into eyes made as Fig. 4. These eyes are fixed one on each side of the body. The frame is secured at the back by two thumb-screws or bolts, which are tapped into small boss plates let into the body. At a convenient point, a prop, as Figs. 5 and 6, is welded to the frame to take the head joint C (Fig. 1), small props, as Fig. 7, being fixed on at D and E (Fig. 1). The positions of these props are obtained by folding down the head, so that when the joints are on they line with one another. The hoop-sticks F (Figs. 1 and 2) are secured to the cod iron by slat irons (see Figs. 1 and 3), being fixed from the inside by three screws in each hoop-stick. In Fig. 3 the slat irons are shown straight, to give a clearer view of their fixing; but when the head is being fitted, they must be bent sideways a little to bring the hoop-sticks level on the outside. When fitted up, a brass washer should be placed between the irons to ensure clear working. The height given is only approximate; it is the rule to allow 3 ft. 6 in. clear from the seat to the top of the lining, but in a head of this description circumstances must be the guide. The hoop-sticks may be of hickory or ash, ⅝ in. thick, and should be purchased ready bent. Enamelled head leather is best for the covering, though stout American cloth or waterproof sheeting might be used. When the head is covered, a valance plate of iron or of border leather should be fixed on the face of the front hoop-stick to prevent rain running inside, and to hide the tacks used in securing the cloth and leather.

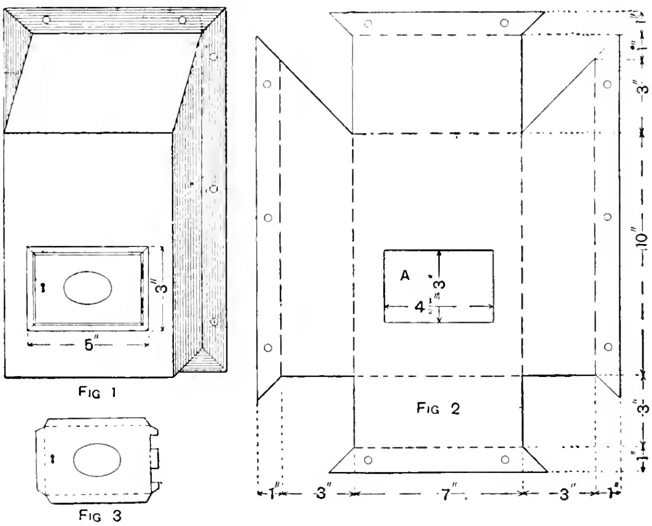


Hood for Invalid Carriage.

Putting New Felloes on Old Wheels.—Generally speaking, wheels that require new felloes all round are worn a little at the shoulders of the spokes. Having split off the old felloes and knocked out the wedges from the tongues of the spokes, carefully examine the tongues. If they are at all worn through working in the old felloe, and the shoulders are worn down, cut all the shoulders down to make them alike. To do this, rest one end of a strip of pine about ½ in. wide on the face of the stock close to a spoke, pass a bradawl through at such a point as is required for the shoulder, and mark all the spokes by this. When cutting down, leave the mark on the front of the spoke, which fits better on the felloe when finished. See that all the tongues are of the same size by trying them with a fitter. The fitter is usually made by boring, with a bit the size of the tongue, two holes about 1 in. apart and cutting out the centres; this will give an elongated hole the diameter of the tongue. If a pattern has to be made for the felloes, measure the distance from the centre of the stock to the shoulders of the spokes, and fix a piece of panel-board on the bench. With the length from the centre of the stock to the shoulder of the spoke as radius, describe on the panel-board an arc large enough to reach to three spokes of the wheel, and dress out, leaving the line full on in the centre of the pattern, so that when the pattern rests on the shoulders of the spokes it is slightly off the end ones. Gauge the pattern round to the required depth, and having got the felloes, face them up true and straight on the face, get out the inner sweep or belly to the pattern, and square; then chop them round the back ⅝ in. wider than the width of the spoke and ¼ in. less in depth. The felloes are now ready for cutting in. To do this, turn the wheel face downwards on a tub, and cut the felloes to such a length that each joint comes central between each pair of spokes; thus each felloe should reach to the centre of three spokes. The joint, when cut, should be slightly open at the top; this can be obtained by trying with a small bevel in the centre of the felloe, marking alongside of the blade, reversing the bevel, and altering until the desired joint is obtained, cutting each end off to this bevel in the depth and square across in the width. When all the felloes are done, they should rest against the shoulders of the spokes and just meet at the joints; mark each side of the tongues on the face of the felloes, number them in rotation, and take them off to bore the tongue and dowel holes. If the wheels are dished considerably, it is necessary to bore the holes for the tongues slightly forward to bring the sole of the felloes square with the ground line; but in a good ordinary wheel, bore the holes square through, so that the felloe will project beyond the front of the spoke ¼ in. The dowel holes are bored rather towards the top in depth and central in width; care must be taken to bore them parallel with the face of the felloes and horizontal in length. The felloes are now rounded up. Drive them on, a little at a time (of course, first putting a dowel in each right-hand end when the face is to the right of the worker's arm), striking the far side of the tongue from the joint. When they are nearly down on the shoulders, put a wedge in each tongue, noting that the wedges are a trifle narrower than the tongue hole. Go all round the rim, gradually working the felloes down into place by giving a wedge a blow, and then a felloe, and so on. When all the felloes are down and of a good fit (if not correct at first, the spokes should be kerfed in with a pad saw at the shoulders), face the wheel round on the front, gauge off full ⅛ in. for the round of the face, then the width of the tyre, rounding up the front and back to these lines; clean off the joints in the belly of the felloes, and round over to meet the rounding on the face. Clean off any unequal places on the sole, file up and sandpaper, and the work is ready for painting. If the ends of the spokes come flush with the back of the felloe, they should be slightly gouged out before the tyring is done.

Preservatives for Paste.—Certain substances are added to flour pastes, liquid glues, etc., to prevent them turning mouldy. Alum is a moderately good preservative for paste, though not absolutely protective; the paste should be kept in a dry place in a closed bottle. A very small quantity of oil of cloves, carbolic acid, or corrosive sublimate will prevent mould forming; use only a mere trace of these, as they are poisonous.

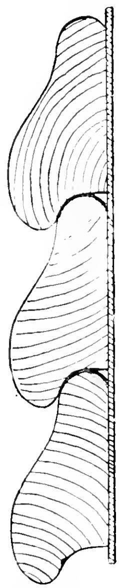
A Letter-box in Sheet Metal.—The letter-box shown by Fig. 1 is made of tin-plate of the thickness known as D X X X. Set out the pattern (Fig. 2), punch holes along the edges for the screws that fasten it to the door, and cut out the piece A either to the size given or larger if preferred. On a hatchet stake, set off at right angles the four flanges represented by the outer dotted lines. Now bend backwards over the same tool the two sides and the bottom along the inner dotted lines. The top is bent in the same manner, but lastly, owing to the taper. See that the corners mitre correctly, and then solder them strongly from the inside. The door (Fig. 3) should first be cut about 1 in. wider and 1 in. longer than the rectangle A (Fig. 2). It is then notched for the hinges, and at the corners, and an oval piece, or a diamond if preferred, is cut from the centre. Wire the door to the dotted lines, and bend two straps of tin (cut to fit the notches) over the exposed wire at the notches. These, when sunk over a sharp-edged tool or in a crease-iron, will form the hinges. To ascertain where to cut the keyhole, hold the lock at the back of the door at ¾ in. from the edge, and press well to the door. The lock pin over which the key fits will thus mark the position of the keyhole, which should be punched larger than the barrel of the key and finished with a small file. The lock can now be soldered in position. A rectangular piece of glass smaller than A (Fig. 2), yet larger than the oval in Fig. 3, is required. Fix this to the back of the door with four small tabs, which must have been soldered on previously. Lay the door over the hole in the letter-box, adjust so that the lock will answer satisfactorily, and then solder the hinges to the box. For a bead frame for the box door, cut two strips of tin ⅛ in. longer than the length of the door, and two ⅛ in. longer than the width, each to be ⅜ in. wide; sink them half round in a crease-iron, mitre the corners, and solder them to the letter-box around the door, so that it will drop in freely. Scrape and file off superfluous solder, clean well with emery cloth, and then paint and varnish the box to suit the door on which it is to be fitted.



A Letter-box in Sheet Metal.

Making a Macadam Road.—One of the essential requirements of a good road is a solid foundation, and without this it is impossible to keep the contour and the surface in good condition. After the excavating has been done, good hard stone pitching should be packed edgewise from 9 in. at the channel to 15 in. in the centre of the road; see that these stones are packed close. Go over the pitching with nobbling hammers, knocking off any prominent pieces of the stone. Put on the top a quantity of small scappling or hard bricks, and break these up, so as to fill all open spaces. A coating of good clinking cinder, rolled in with a heavy horse roller, will make a good compact foundation for the macadam. Iron ore slag or copper slag, if available in the district, will serve admirably for the next coat. Spread a coating of either of these materials, or of granite to pass a 3-in. ring, from 3 in. thick at channels to 6 in. in the centre of the road, and then traverse the work with a steam roller. The road will now be ready for top capping, a most important operation. The granite should be of good quality, hard and durable, with good weather-resisting properties, and should be broken to pass a 1½-in. ring. The pieces should be angular; anything of a flat, chippy nature should be avoided, for it cannot be rolled into a compact mass, and the traffic very soon wears it away to sludge. Give the road a uniformly thick (2 in. to 3 in.) coating of this material; then run the roller on the sides, and work to the centre. The next material required is the binding, which must be chosen carefully. One of the best binders is a fine sandy gravel, and one of this to six of material is a fair proportion. This having been spread on the road, water it freely, brush well in with stiff brooms, and fill up all slack places as the rolling proceeds. When the surface has begun to assume a mosaic-like appearance, and the binding begins to accumulate on the top, it should be swept into the channels. Fine granite chippings are rolled in at this stage, for the purpose of filling up all interstices between the larger stones, but if ½-in. angular stones were used for this purpose the road would be much more free from sludge, for on any road on which the traffic is heavy the thin chipping must very soon be ground to dust.

Making Roll-shutter for Roll-top Desk.—The accompanying illustration shows a good form of section for the roll-shutter of an American roll-top desk. Each strip of wood is moulded to the section and firmly glued to a backing of stout canvas. Before gluing, the edges which are in contact should be rubbed with linseed oil to prevent any glue adhering; do not oil the part that is to be glued. The sections shown are actual size.



Section of Roll-shutter for Roll-top Desk.

Sizing and Varnishing a Papered Room.—Below are instructions on revarnishing the walls and ceiling of a room covered with sanitary paper. Well wash the ceiling and walls with warm water and ox-galls—½ pt. of the latter in 1 gal. of water. Then give a covering of glue-size (¼ lb. of best Scotch glue in 1 gal. of water), applied with a sponge. The size should be allowed to dry for twenty-four hours before applying the varnish. Do not use crystal or paper varnish. For the walls, get ½ gal. of good kauri varnish, 1 qt. of turps, and 1 qt. of raw oil. For the ceiling, use turpentine varnish.

Making Zinc Yellow.—Zinc yellow is a chromate of zinc mixed with oxide of zinc. To make zinc yellow, boil separate saturated solutions (1) of 29 oz. of sulphate of zinc in water and (2) 20 oz. of chromate (not bichromate) of potash in water; mix, boil for one hour, collect the precipitate on a filter cloth, wash several times with water, and dry at a low heat. Another method is to dissolve 12½ oz. of bichromate of potash in hot water; mix 6 oz. of zinc oxide to a cream with water, and stir it into the bichromate solution. Allow to stand for twenty-four hours, boil for one hour, then filter, wash, and dry.

Varieties of Marbles.—The table of the better-known marbles given below has been compiled chiefly from Lee's "Marble and Marble Workers," though other authorities have been consulted as well. Marbles may be classified in different ways, but perhaps the most convenient method is to divide them into seven colour-groups — black, brown, green, grey, red, white, and yellow. A sharp division line between these colours cannot be drawn in all cases, but the classification holds good for most practical purposes.

Name.	*Predominant Colour.*	*Whence Obtained.*	*Remarks.*
Ashburton	Grey	England	Dark veins on grey ground.
Bardilla	Grey	Italy	Darkly veined; hard, brittle, often contains holes, and is easily broken whilst working.
Belgian Black ...	Black	Belgium	Very hard; is the best black marble.
Belgian Fossil	Grey	Belgium	White spots and markings on grey ground.
Belgian Grand Antique	Grey	Belgium	Large white veins on black ground.
Belgian T	Grey	Belgium	Brownish red patches on grey ground.
Bianco e Nero Antico	Grey	Algeria	White veins on black ground.
Bird's Eye	Brown	England	Brownish grey with spots of lighter colour.
Black and Gold	Yellow	Italy	Large yellow and white veins on black ground.
Black Vein	Grey	France	Large white veins on black ground.
Blue Belge	Grey	Belgium	Sound; white veins on grey and black.
Breccia Sanguina ...	Red	Algeria	Light red patches on deep red ground.
Brèche Portor ...	Yellow	France	Greyish black; finely pencilled with brown and yellow.
Brèche St. Antonin ...	Yellow	France	Unsound, but polishes well; red and brown patches on yellow ground.
Brocatelle Jaune ...	Yellow	France	Brown and white veins on yellow ground.
Brocatelle Violette ...	Red	France	Grey and yellow patches over purplish red.
Comblanchien ...	Brown	France	Light brown; good texture.
Connemara	Green	Ireland	Grey and black patches and veins on green ground; contains holes.
Coquille	Grey	Belgium	White spots and veins on black ground.
Derby Black	Black	England	Deep black, close texture, and takes good polish.
Derby Fossil	Grey	England	White fossils on grey ground; hard, and takes good polish.
D'Hechette	Grey	France	White veins on greyish black ground.
Dog Tooth...	Brown	England	Reddish brown fossil marble.
Dove...	Grey	Italy	Lavender or dark grey slightly veined; resembles Sicilian, but is harder.
Draycot	Red	England	Hard, but does not polish well; red conglomerate.
Duporth	Green	England	Soft and easily worked, but does not take good polish; mottled green.
Emperor's Red	Red	Portugal	Bright red and takes good polish.
Florence	Grey	Belgium	Dull grey fossil marble.
French Black	Black	France	Of poor quality; spotted.
Genoa Green	Green	Italy	Dark patches, white and grey veins over dark green.
Giallo Antico	Yellow	Tunis	Close texture and takes good polish; reddish yellow of many shades.
Giallo Avorio	Yellow	Algeria	Pink and yellow markings and red veins on cream ground.
Giallo Canarino... ...	Yellow	Algeria	Pink and red veins on yellow ground.
Grammont	Yellow	France	Resembles Médoux, but less yellow and not so finely marked.
Grand Antique	Grey	France	Black and white markings in sharp contrast.
Griotte d'Italie	Red	France	The best of red marbles; black veins and white shells on deep red ground.
Gris de Barse	Grey	Belgium	Brownish red markings on reddish grey ground.
Historique	Grey	Belgium	Black ground with white veins and fossils.
Iberian Agate	Red	Portugal	Yellow and brown markings on purplish red ground.
Irish Black	Black	Ireland	Deep black and fairly easy to work.
Irish Fossil	Grey	Ireland	Dark grey ground.
Isabelle	Red	France	Fawn spots and greyish green veins on dark red ground.
Istrian	Brown	Austria	Even texture; weather-resisting; cream colour.
Jaune Lamartine ...	Yellow	France	Rich yellow, finely pencilled with red and brown.
Jaune Oriental	Brown	Belgium	Reddish brown, mottled with grey, red, and pink.
Jaune Oriental ...	Grey	Belgium	Reddish grey; hard, and takes good polish.
Jaune St. Beaume ...	Yellow	France	Fine red and brown veins on yellow ground.
Jaune Victoria	Yellow	Germany	Dark yellow with fine red, purple, and white spar veins.
Joinville	Brown	France	Light fawn colour mottled with brown and red.
Kilkenny	Grey	Ireland	Dark grey patches and white fossils on black ground.
Languedoc	Red	France	Large white veins on bright red ground.
Lilas	Grey	Belgium	Greyish brown and slightly marked.
Luma Chelle	Grey	France	Patches of fawn colour tinged with red on grey ground.
Lunel	Brown	France	Light fawn colour with few markings.
Lunel Fleuri	Brown	France	Light fawn colour flowered with dark brown.
Malplaquet	Red	Belgium	Grey and white veins over brownish red.
Médoux	Yellow	France	Brecciated, with black, red, yellow, and white patches.
Napoleon	Brown	France	Red and brown veins on light fawn ground.
New England	Brown	England	Grey veins on purplish brown ground.
Onyx	White	Algeria	Semi-transparent, with yellowish white tinge; sometimes veined.
Pavonazzetto	Yellow	Italy	Purple and black veins on yellowish white ground.
Pavonazzo	Yellow	Italy	Purple and black veins on yellowish white ground; coarser veins than Pavonazetto.
Penmon	Brown	England	Light brown mottled with grey, and dark brown.
Pettit Tor	Grey	England	Hard, and takes good polish.
Purbeck	Green	England	Obtained in small blocks; mottled greenish grey.
Red Ogwell	Red	England	Fine markings over red.
Rosa Carnagione ...	Red	Algeria	Yellowish patches and red veins on flesh-colour ground.
Rose	Red	France	Black markings over red; sound, and takes good polish.
Rose Enjugeraie ...	Red	France	Pearly grey patches and bright red veins on red ground.
Rosso di Levanto ...	Red	Italy	Light veins on deep purplish red ground; contains holes.
Rouge Acajou	Red	France	Mottled rose red; takes high polish.
Rouge Antique	Red	France	Dark red; obtained in small blocks only.
Rouge du Var	Yellow	France	Irregular patches of red and white on yellow ground.
Rouge Etrusque ...	Red	Algeria	Ground of dark red having brown veins and spots touched with bright yellow; takes good polish.
Rouge Fleuri	Red	Belgium	White flowered veins over dark red.
Rouge Griotte	Red	Belgium	White veins over dark red; best of Belgian red marbles.
Rouge Rose	Red	Belgium	Grey and white veins on red ground.

Name.	Predominant Colour.	Whence Obtained.	Remarks.
Rouge Royal ...	Red	Belgium	Grey veins and white patches on red ground; contains holes.
Russet	Brown	England	Deep brown, mottled.
St. Amande	Grey	Belgium	Dove colour with reddish tint.
St. Annes	Grey	Belgium	Sound and of close texture; grey and black, flowered and veined with white.
St. Béat	White	France	Very pure, but inferior to Carrara statuary.
St. Sylvester	Red	Portugal	Sound and takes high polish; flesh-colour ground with dark red and white veins and light brown and white patches; very handsome.
Sarrancolin	Red	France	Fawn and dove markings over red.
Sicilian	White	Italy	Hard and white, with bluish cast; best quality bears exposure well.
Sienna	Yellow	Italy	Ground ranges from white to brown through all shades of yellow; purple and black veins.
Statuary	White	Italy	Rarely obtained quite pure; the best comes from Carrara.
Statuary Vein	White	Italy	For statuary work; more or less veined.
Vein	White	Italy	White, with veins.
Verde Antique ...	Green	Italy	White veins on deep green; the best of the Genoa marbles.
Verde di Levanto ...	Green	Italy	Purple and red veins on green ground.
Verde di Pegli	Green	Italy	White veins on green ground; contains holes.
Verde di Prato	Green	Italy	Obtained in small blocks only, and takes high polish; dark spots and white veins over deep green.
Verona Red	Red	Italy	Fawn-colour patches on light red ground.
Vert d'Arriège	Green	France	Light and dark green veins on white ground.
Vert Isabella	Green	France	Green and white veins on fawn-colour ground.
Vert Maurin	Green	France	Sound, and obtained in large blocks; white veins on dark green.
Vert Moulins	Green	France	Green patches and veins and white spots on red ground.
Victoria Red	Red	Ireland	Mottled light red.
Waulsort	Brown	Belgium	Fairly sound and takes good polish; dark brown with patches of white, black, red, and pink.

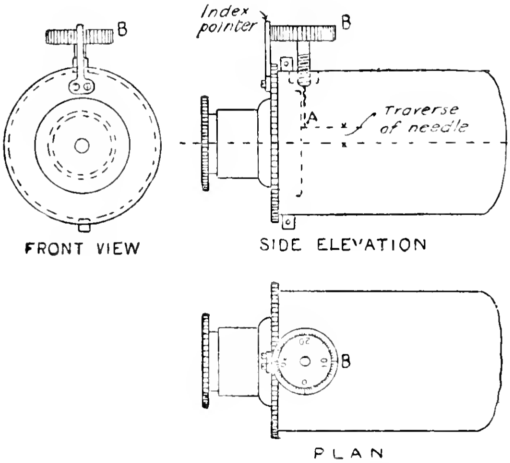
Cutting and Polishing Diamonds.—The processes through which a piece of carbon passes in the course of its conversion into a natural diamond are not known to man; all that is known is that the carbon crystallises. The natural home of the diamond is supposed to be a rocky matrix; but this is theory only, there being no evidence that a diamond has been discovered so situated. The mountains that supply the débris in which the gems are contained are composed of schistose rocks intermixed with quartz, sandstone, brescia, flinty slate, limestone, etc. All that is actually known concerning the original position of the diamond is that the only rock in which it is found in the mountains is the limestone brescia. Of course, as discovered, the rough gems are quite dull and lustreless, and it is necessary to cut and polish them; there must be principal planes or faces, and around these a considerable number of smaller ones placed at correct angles, so that by refraction a blaze of light, whose every ray is in harmony with the rest, may result. The facets must be so cut that light, in passing through, is refracted in such a way that a maximum of brilliancy is obtained. The diamond being the hardest of known substances, its own dust is the only available material with which it may be polished and worked. The dust is obtained by grinding up worthless diamond particles in a steel mortar, the minute fragments obtained in the working of the diamonds also being saved for the purpose. Bort diamonds, black or grey carbon partly crystallised and found in conjunction with the ordinary diamond, are also used, these being just as hard as the clear diamond. By rubbing two diamonds together, they are mutually abraded or worn away; hence, a valuable diamond is cut by rubbing it with a comparatively worthless black one of equal hardness. Both clear and black or bort diamonds are fastened in the ends of sticks of cement, the black one having its cutting angle so placed that it may be used to the best advantage. The workman holds the clear stone in his left hand, and rubs it with the black one held in the other hand, the dust produced by the abrasion falling into a double metallic box whose inner receptacle has a perforated bottom; the coarser particles left in this receptacle must be powdered in a steel mortar for use as a diamond polishing medium, whilst the powder that has passed through the perforations is already sufficiently fine for the purpose. Diamond cutting is slow and tedious work, and requires the utmost care and skill. It is possible to split or divide a diamond if advantage is taken of its grain or cleavage plane. Sometimes a large piece is split off a stone, and the time and expense of a prolonged abrading process avoided; but the splitting operation is a risky one. The stone is studied closely, and its line of cleavage is ascertained; it is then cemented to a suitable support. The sharp edge of a razor-like chisel is carefully adjusted to the line of cleavage, and a smart rap with the hammer is given to the chisel. If the splitting is successful, much expense will have been spared; if unsuccessful, it is likely that the diamond is spoiled, and is comparatively worthless. In the polishing of the cut stones use is made of a turn-table. In Holland, which for many years monopolised the diamond cutting and polishing industry, ponderous machinery was employed, the wheels being braced and wedged like the running-gear of a sawmill. Since 1870 or so much interest in the industry has been awakened in America, where a lighter, more compact and serviceable machine is in use. It is a small iron-top table having solid iron supports and double bearings, so that the polishing wheel in the centre revolves horizontally with its surface flush with that of the table; perfect steadiness is obtained with this machine. The cut stone to be polished is fixed in soft lead heaped conically in a copper cup, and the flat surface of the wheel is charged with a paste of diamond dust and oil. The copper cup holding the diamond is placed in a heavy iron clamp, in which it is held inverted above the polishing wheel, which is then made to revolve at the rate of about 1,500 revolutions per minute. Nothing but the diamond presses upon the wheel, a rather musical sound being produced by the contact if the wheel is doing its work. When one facet has been polished, the wheel is stopped, the lead in the copper cup melted, the diamond reset, and another portion of the diamond is worked. Most careful measurements and experiments are necessary in polishing a diamond, so that accuracy of angular proportion in the facets is obtained.

Chemists' Show Bottles.—The following supplements the information given on p. 13. In filling show bottles, first put in sufficient distilled water and add the concentrated colouring solution, made as below, so as to give a tint which, with a light behind it, shows up better than a decided colour. The greater proportionately the diameter of the bottle, the less colour will be required. For a blue liquid, dissolve 1 oz. of blue vitriol in ½ pt. of water, and add sufficient ammonia water to dissolve the precipitate first formed. A green liquid may be made by adding bichromate of potassium to the above blue one; if turbid, add ammonia water. For purple, dissolve 1 gr. of salicylic acid in 2 fluid drachms of alcohol and 2 oz. of water; add 30 drops of tincture of chloride of iron dissolved in 2 oz. of water. For red, dissolve ½ dr. of iodine by means of ½ dr. of iodide of potassium in ½ pt. of water, and add 1 oz. of muriatic acid. An orange tint is obtained by dissolving bichromate of potash in water. For yellow, dissolve 3 parts of bichromate of potash and 2 parts of carbonate of potassium in water. To prevent the bursting of the bottles by freezing, alcohol or glycerine should replace a part of the distilled water used for thinning the colouring solutions.

Making Imperial Yellow.—Imperial yellow is a sulphide of arsenic, and the materials employed in making it are very poisonous. Three parts of white arsenic are mixed with 1 part of powdered sulphur, and the mixture is heated in an iron pan provided with a cover, into which the sulphide sublimes in a solid mass. The pigment is simply coarsely ground, as its colour is not improved by fine grinding.

Purifying Zinc.—The method generally adopted commercially of purifying zinc is to melt the metal in a reverberatory furnace having an inclined bed, in which the metal collects, and the lead, being of heavier specific gravity, falls to the bottom. This allows the impurities to oxidise and form a scum on the top of the metal. Of course, the metal is kept just at melting point, otherwise a large loss of zinc by volatilisation results. It is practically impossible to purify zinc on a small scale. A plan that might be tried (although its success cannot be guaranteed) would be to melt the zinc under a thick layer of flour charcoal. Should there be any bismuth or arsenic in the metal, these impurities might be driven off, as they volatilise at a much lower temperature than zinc. Lead, which would be the largest impurity, would separate out and would be poured last, so that the major portion of the zinc would be comparatively pure.

Wells System of Measuring Distances.—The accompanying figures show the Wells apparatus used by surveyors for judging distance when taking trial levels without chaining the horizontal distances. It may also be used as a check upon chained measurements. The apparatus consists of a needle point A attached to the diaphragm of any levelling telescope, and movable in a vertical direction so that its distance from the horizontal cross-hair or wire may be regulated by the micrometer screw



Wells System of Measuring Distances.

B, the top of which is graduated, as shown in the plan, to serve as a reference in setting the needle point. The index-pointer to this graduated circle is fixed upon the front of the telescope over the eye-piece, as shown in front and side elevation. The needle, which is worked up and down by the micrometer screw B between the limits marked "traverse of needle," travels in the same vertical plane as that in which the cross-hairs are fixed. To set the needle, measure any distance, say 100 ft., upon level ground, set up the level so that the telescope stands over one end of the measured distance, while the staff is held at the other end. Focus the telescope accurately, and move the needle-point A in the diaphragm by the screw-head B until exactly 1 ft. of the staff image is enclosed between the needle-point and the horizontal cross-hair in the diaphragm. In this way a datum distance reading may be obtained, from which other distances of varying lengths can be easily calculated. The divisions upon the top of the screw B (see plan), where the index-pointer touches, should then be noted for future reference.

Crazy China-work.—Jars decorated by crazy china-work, or china patchwork, form useful and ornamental vases, pot-pourri jars, etc. Take an ordinary brown earthenware stew-pot, together with its lid, thoroughly wash them, and allow to dry. Cover the outsides of the jar and lid with putty to a thickness of ½ in. or so. This putty is the ordinary material, to be obtained at any oil-shop, and may be made by well mixing 2 lb. of sifted whiting with ½ lb. of dry white lead, and then making into a stiff paste with raw linseed oil. After standing for a few hours, work it up in the hands, and then it is fit for use. The miscellany of odds and ends with which the jar is decorated includes broken china, bits of crockery, coloured glass, buttons, shells, little pieces of flint, etc., and all these must be washed thoroughly, and allowed to dry before being applied; they should be broken up so as to be not more than ¾ in. in diameter, and are embedded in the putty just as fancy dictates; it is not desirable to make any attempt at producing a pattern. If the putty is allowed to bulge out between each two pieces of china, it should be touched up with gold paint when dry. It is a matter of taste; but, in many opinions, gold paint does not improve china patchwork. Instead of the ordinary putty, a cement made as follows may be used. Stand a stone jam jar half filled with melted glue in hot water, and stir in whiting until the mixture is of the consistency of cream, and with this coat the article to be decorated, and allow to dry. Thicken the composition by adding whiting whilst hot, and apply the paste to the already coated, but dry, articles. The china fragments are then embedded; this ground is affected by water. Besides vases, such articles as drain-pipe umbrella stands, flower-pots, plaques (having a papier-maché or tinplate base), photograph frames, jardinières, etc., may be decorated in crazy china-work. In cases where the base is a very porous one, as, for example, an unglazed flower-pot, a coat of common varnish may precede the application of the putty.

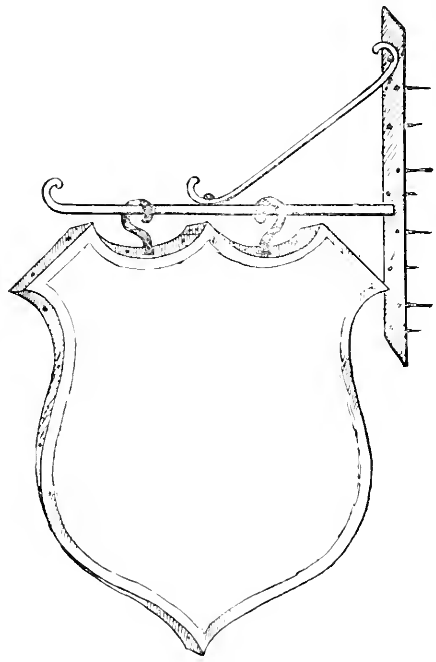
Drilling Holes in Glass.—In order to drill a hole in glass, it is necessary to have a hard and well-tempered steel drill. This may be prepared by heating to a dull red, and then plunging into mercury so as to become hard. It is, however, necessary to temper the shaft of the drill. Imbed the point of the drill in a piece of lead. The temperature of the shaft of the drill can be raised by means of a blow-pipe till there is a blue colour nearly to the point. The drill and lead together are now immersed in cold water, when the first will be ready for work. This tool, when mounted in a holder and with the point moistened with turpentine, attacks glass rapidly. Do not press too heavily when working the drill, and, if possible, work from both sides of the glass successively. To enlarge a hole thus obtained, use a rat-tailed file soaked in turpentine. A steel drill may be hardened, when at a red heat, by dipping it into any cool liquid. Another method is to saturate commercial muriatic acid with zinc—do this in the open air. The drill should be ground before hardening. When at a red heat, dip it in the solution to harden; or a spear-shaped drill, heated to a red heat and hardened in mercury, and then sharpened on an oilstone, may be used. Still another method is to forge a drill at a low temperature and harden it in water. The drill is firmly rotated at the desired spot with an alternate motion, and lubricated with a saturated solution of camphor and spirit of turpentine. Dilute sulphuric acid may also be used as a lubricant. A very simple tool for boring glass is a drill made by heating an old three-cornered file, which is then cooled slowly in ashes. The end is filed to a conical shape and again heated, and then hardened by plunging into water. The drill is fixed in a brace and rotated, turpentine being used as a lubricant. To remove the drill from the hole, rotate the drill in the reverse way. A reliable method of drilling holes, in which a tube is used, is as follows. Make a drill from brass tube of the required diameter, and into the non-cutting end drive a piece of wire to project somewhat, and file the projecting part to fit a drill-stock. The cutting end of the brass tube is next to be slotted with a few saw-cuts running parallel with the tube's length; the inner ends of the cuts must terminate in holes drilled, before the slots are cut, at right angles to the tube's length. The number of slots required depends upon the diameter of the tube used. Two pieces of wood, measuring, say, 3 in. wide, ¾ in. thick, and long enough to span the piece of glass, are screwed firmly together with ordinary wood screws passing through near the ends, whilst through both pieces of wood a hole is bored large enough to admit the drill freely. This hole through the wood is to be countersunk at both ends. The two pieces of wood are next separated, by partly removing the screws, and the glass is placed between them to be held as in a kind of clamp, the hole for the drill being brought exactly over the spot where the glass is to be bored. Some 90 or 120 grade emery powder mixed with water is then placed in the countersinking to act as a grinding agent. The drill may be worked as fast as possible, though not so quickly as to splash out the wet emery. When the drill is half-way through the glass from one side, a hole should be started from the other side and completed, to prevent the chipping of the edges. Holes from ¼ in. to 2 in. diameter can be bored with this appliance. It takes about four minutes by this method to drill holes up to ½ in. diameter in a sheet of glass ¼ in. thick.

Making Artificial Oilstones.—One way of making artificial oilstones is to mix finely powdered sand with a small quantity of shellac; heat the mixture, then place it under great pressure in a mould and allow to become cold.

Use of Sensitometer in Photography.—A sensitometer (or actinometer, as it is sometimes called) is an instrument for measuring the sensitiveness to light of photographic plates and paper. In certain printing processes in photography, such as the carbon and the dusting-on processes, the action of light does not cause any visible change in the sensitised material exposed under the negative, and the latent image has to be developed after the exposure has been made. In these circumstances, therefore, it is important to adopt some method by which a correct exposure may be ensured. Although the sensitiveness of the paper may be known, two unknown factors, namely, the density of the negative and the actinic power of the light, render any calculation to ascertain the correct time of exposure impossible. It is to overcome this difficulty, therefore, that the sensitometer has been devised. The sensitometer consists of a series of tiny negatives of different densities; under the negative that matches the working negative is placed a strip of any printing-out paper that prints a visible image, and when this test piece of P.O.P. is printed to the required depth, the print from the other or working negative is also sufficiently printed. A simpler form of sensitometer consists of a small box inside which a strip of printing-out paper is coiled; a portion of this paper is brought beneath a piece of coloured glass and exposed till it reaches a standard tint painted round the glass. Experience alone teaches how to allow for the difference in contrast in the negative and the print and for the variation in light. Carbon, for example, is proportionately more sensitive than silver when the light is dull; and, if the light is particularly rich in ultra-violet rays, the silver chloride would have an advantage. A sensitometer is sometimes used in platinotype printing, but in this case the faint primary image itself acts as a sensitometer and is a good guide to an experienced printer. A rough form of sensitometer may be made by pasting a number of strips of tissue paper one on the other, each successive strip being about ⅛ in. shorter than the preceding, thus forming a scale of density. An almost equally satisfactory plan is to utilise as a scale different parts of a negative having a good range of density, using, of course, a strip of paper sufficiently long to allow of the frame being opened without moving the paper. Sensitometers for testing the speed of bromide plates and papers are formed on somewhat the same principle.

Renovating Piano Keys.—In removing scratches from piano keys, first find out whether the key coverings are of ivory or celluloid by wiping them over with methylated spirit; if they are of celluloid, a strong smell of camphor will be emitted. The scratches, if deep, can only be removed by taking a thin shaving off the surface of the key; if not deep, polishing with fine grade pumice powder and benzoline may be tried. If it is necessary to remove the upper surface, the keys should be dealt with one at a time by placing them on a block, on the face of which has been nailed two strips of wood to form a groove. If a suitable iron plane is not available, a finely set smoothing plane may be used, though good work can be done with a cabinet-maker's steel scraper and glass-paper. If the key coverings are of celluloid, use, instead of a plane, No. 1 and No. 0 glass-paper, held tightly over a cork pad. When all scratches have been obliterated and the surface of the keys is quite level, and the sharp edges are removed by gentle rubbing with worn paper, the polishing may be done. Polishing pads are made by tightly stretching several thicknesses of woollen cloth or a piece of felt across a smooth board, and by its side a piece of chamois leather; cloth and leather should be so secured that the nails cannot get in the path of the keys. Ivory keys may be polished by liberally sprinkling the cloth or felt with methylated spirit, then rubbing whiting on till a thin paste is formed. The keys should be done one at a time, turned face downwards. Rub briskly to and fro till a fair polish is gained. The surplus moisture is wiped off with a piece of rag, the final polish being imparted with the chamois pad, on the face of which has been sprinkled some dry whiting, or, better still, some putty powder. Celluloid keys are similarly polished, except that finest grade pumice powder and benzoline should be used instead of whiting. As the nature of celluloid varies, it may be necessary to use putty powder and oil in order to gain a first class polish; in that case, use a separate pad. Benzoline, owing to its inflammable nature, should not be used near any source of artificial light.

Making a Projecting Swinging Sign.—The projecting swinging glass-faced sign affords a permanent advertisement, and is made easily. The design should first be drawn in every detail. Next get a deal board about ½ in. thick and of the width and height of the shield, or whatever shape determined. Lay a paper pattern of the design on the board, mark round with a pencil, and with a keyhole saw cut out the shape, taking great care not to crack any of the corners or in any way damage the curves in working. Round this shaped board is put a 1½-in. rim of thin hoop-iron, having holes punched in the centre in various places, as well as two holes to screw in the hooks for hanging, as shown partly in the accompanying illustration. Then bend the rim round the wooden shield and fix with round-headed screws. When this is overlapped at the top about 1½ in. for strength, there will be ½ in. of rim on each side, which is ample for glazing. Next take the paper template and cut off about ⅛ in. bare all round, and have two glasses cut to this size in 15 oz. clear glass. Try them in the shield frame, and see that they fit easily and do not pinch at any of the corners. Then set out the wording for the sign, which must be put on the back of the glass and backwards. The way to do this is to make the drawing upon tracing paper, which, when turned over, presents the lettering backwards and ready to place beneath the glass; then trace in the colour desired. The enamel-paints sold in small tins would do well for this work, and, being supplied in many varieties of colours, afford a choice and scope for arrangement. Of course, in choosing colours for an advertisement, striking contrasts, not too glaring, are the best, as they draw attention. Using white letters with a chocolate background, or black letters with white or sky blue background, and so on, any number of different arrangements can be applied, and it remains with the worker to choose the colours so that the projecting sign, when finished, will not look unsightly if compared with its surroundings. Get a small brush called a writer, and trace in all the letters in the desired colours, taking care to keep the colours properly thinned with turpentine and not to get a thick body of colour on that will take a long time to dry. When all the lettering or design is traced in, put aside for a day or two to get thoroughly dry and hard, and then paint in the background with an ordinary sash tool. Of course, there will be two glasses to do, one for each side of the sign, and different wording can be arranged, so that there will be two announcements on one sign. When both glasses are finished they are ready for glazing. The putty for this should be mixed with a little colour, making it the same, or nearly the same, as the colour of the background. Lay the glass in the frame and putty round. The bracket is made with three pieces of iron. The upright, to be screwed to the wall, is a piece of sheet-iron about 2 in. wide, with holes for screwing. The projecting bar is fixed to the upright and curved at the end, and the support at the top is riveted to the upright and horizontal bar as a strengthener for the latter, which supports the sign. The sign should not be fixed lower than 7 ft. from the pavement.



A Projecting Swinging Sign.

Flatting for Steel Castings.—To make a flatting or filling for rough steel castings, mix together 1 lb. of white lead and ¼ lb. of terebine; thin down with turpentine till the mixture is of the consistency of paint. This flatting will dry quickly and leave a smooth surface, on which the finishing colour may be applied. Black is generally used. To make a good black, mix ½ lb. of white lead with 1 oz. of driers or litharge; then add the black pigment, ground in oil, to the required shade, and thin down with turps till the whole is of the consistency of paint. Another mixture consists of 1 lb. of black paint, 7 oz. of linseed oil, 2 oz. of turpentine, and ¾ oz. of litharge. Mix the litharge with the paint, then add the oil, and finally the turpentine.

Design for Front of Pigeons' House.—Figs. 1 and 2 show front elevation and side elevation respectively of the front of a pigeons' house, about 9 ft. long, 4 ft. 4 in. high at the sides, and 6 ft. 8 in. high in the centre, including the turned finial. The framing should be of wood about 3 in. by 2½ in., mortised and tenoned

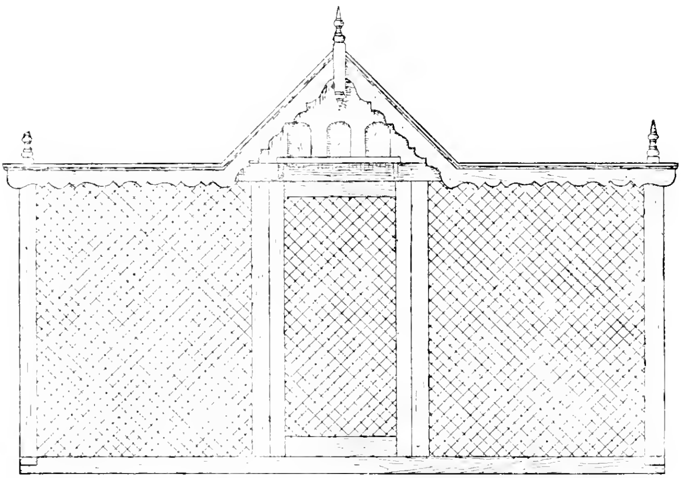


Fig. 1

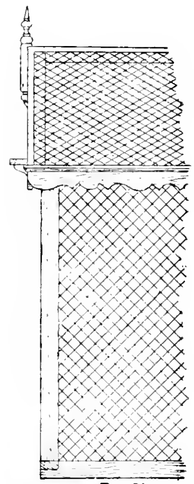


Fig. 2

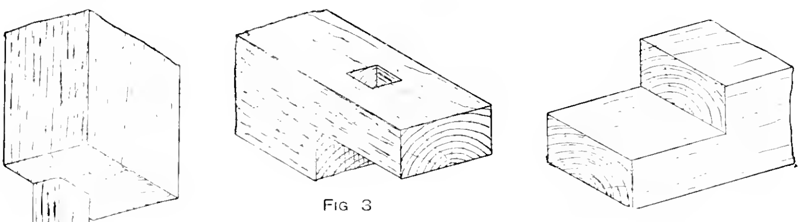


Fig 3

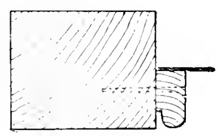


Fig 4

Design for Front of Pigeons' House.

together. The joint at the angle of the sill-pieces and angle-posts is shown at Fig. 3. The appearance would be improved by fixing strips of ¼-in. or ⅜-in. bead along the vertical edges of the posts, and the wirework could be fixed to this as indicated in Fig. 4.

Staining and Wax-polishing Wood Carvings.—The following is a description of how wood carvings are finished by staining and wax-polishing. Before staining wood carvings, the surface must be made very smooth to prevent the wood swelling on the application of the stain. For this purpose, polish the surface with a wad of very thin soft shavings, firmly pressing with the hand until a faint lustre appears. Fine varieties of wood should not be stained. Walnut, pear, oak, plum, and mahogany retain their natural colour, and are waxed only and subsequently brushed, by which means they attain a somewhat darker tone and antique appearance. A handsome dark-brown shade on walnut is obtained by first coating the wood with linseed oil in which alkanet root has been infused, and polishing after twenty-four hours. A simple method of staining carvings is to coat with a dilute solution of potassium chromate and then with a dilute solution of potassium permanganate. By varying the strength of the solutions and the number of applications, all woods, from the hardest to the softest, can be stained effectively. It is wise to try the stains on a piece of board first; after staining with the potassium permanganate, wash out the brush in water, or the salt will destroy the bristles. An antique shade on oak carvings is obtained by staining with umber which has been boiled in water with a little potash. Wood stained in this manner is not polished, but it receives a covering of limpid varnish. For wax-polishing carved work, benzine wax is preferred to turpentine wax because it does not clog the fine lines and notches so much. To prepare benzine wax, put small pieces of white wax into a vessel, cover the wax with benzine, and closely stopper the vessel and allow to stand for a day in a cool place; care is needed in these operations, as benzine is highly inflammable. A thick paste will form; remove a little of this with a knife or spatula and dilute it with benzine in a flat dish to about the consistency of milk, and apply this to the carved work by means of a moderately soft bristle paint brush. After standing for a few minutes, brush out all the corners and cavities with a good bristle brush, when a faint lustre will appear. To give a red tinge to the wax, add a little of an infusion of alkanet in benzine; for blue, add a solution of Prussian blue in benzine; and for a mahogany colour, use Cassel brown. After use, clean the brushes, etc., with a hot soda solution.

Repairing Goloshes.—It is difficult to find a cement that will adhere to the composition of which goloshes are made. Still, the following method of repairing may prove successful. First, the part to be repaired must be roughened with a coarse rasp. If it is soft, cover it with a coat or two of indiarubber solution and serve a piece of vulcanised indiarubber in the same way; when both are nearly dry—that is, just tacky—warm them by a slow fire and then press the patch to its place. When it is set, trim up with knife, file, and sandpaper. If the old stuff is hard, mix some gutta-percha with indiarubber solution by warming the former till it is well melted and then stirring the two well together. This, if not too thick, can be put on with the finger; if it is thick, it may be ironed on with a warm iron, after a coat of plain solution has been applied to the golosh and has dried. Then to repair, a piece of thin sheet gutta-percha can be thrown into hot water, taken out when soft, wiped dry, and then held on the golosh near a fire. When just sticky the two are pressed together, and when cold and hard, finished with knife and glasspaper.

Enamelling Slate Mantelshelf.—The process of enamelling slate, as for instance a mantelshelf, is as follows. A dark lacquer or tar varnish is applied with a brush to the surface of the slate, which is then placed in an oven and baked from twelve to forty hours, according to size, the heat being just sufficient to fuse the lacquer. The slate is then treated with a coat of enamel, and again placed in the oven to harden. This is repeated several times till the surface is perfect and the slab is ready for polishing, which is effected by rubbing with woollen bosses and powdered pumice-stone, finishing off with a little powdered rotten-stone. Scratches cannot be effectually removed from a polished (enamelled) slate mantelshelf; rubbing with an oily rag will, however, soften down the scratches. The only real remedy will be to have the shelf re-enamelled.

Consumption of Gas by Various Burners.—The table below gives the consumption of gas in the different varieties of Bray's flat-flame burners in ordinary use, under a pressure of ten-tenths, or 1 in. With regard to the apparent inconsistency of some of the figures, these are based on tests made at the instance of the Leeds Corporation.

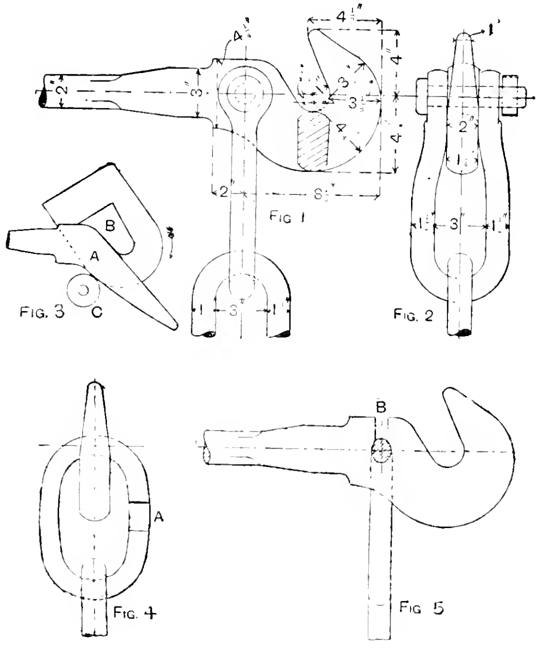
No. of Burner.	*Bray's Regulator Union Jet.*	*Bray's Special Union Jet.*	*Bray's Regulator Slit Union.*	*Bray's Special Slit Union.*	*Bray's Regulator Batswing.*	*Bray's Special Batswing.*
	Cub. ft. per hour.	*Cub. ft. per hour.*	*Cub. ft. per hour.*	*Cub. ft. per hour.*	*Cub. ft. per hour.*	*Cub. ft. per hour.*
0	3·6	3·05	—	—	—	—
1	3·9	4·02	4·8	3·53	4·26	3·86
2	4·9	3·97	5·2	4·22	4·95	4·46
3	4·8	4·90	6·37	4·61	5·64	5·25
4	6·67	5·15	5·88	5·69	6·74	5·55
5	7·97	6·67	8·14	6·37	6·93	5·85
6	8 35	7·65	8·60	7·55	8·82	7·53
7	8·65	8·05	9·04	8·60	10·00	8·72
8	10·60	10·60	9·40	10·00	9·30	9·30
9	—	11·20	10·50	12·60	10·10	9·31

The ordinary Welsbach incandescent burners are of three types. First, the "C" burner, consuming about 3½ cub. ft. of gas per hour, and giving a sixty candle-power light; second, the "S," consuming 2½ cub. ft. of gas, and giving a light of thirty-five candles; and third, the "Gem" burner, consuming 1¾ cub. ft. of gas, and yielding a light of thirty-five candle-power. The "New" Welsbach burner is made in the following sizes:—

No. of Burner.	*Gas Consumption at 1 in. pressure. Cubic feet.*	*Candle-power (about).*
0	¾	20
1	1	30
2	2·2	50
3	3	80
4	3·8	105
7	6·5	185

Gilding Glass by the Chemical Process.—Gold chloride dissolved in distilled water is employed for gilding glass by the chemical process. The chloride is prepared by dissolving pure gold in nitro-muriatic acid, evaporating the liquid nearly to dryness, dissolving the gold salt in distilled water, then neutralising the remaining excess acid by the addition of soda. The solution should contain 100 gr. of gold chloride in 1 pt. of water, and must be filtered through blotting paper before use. Four-fifths of this gold solution must then be mixed with one-fifth of a solution made by dissolving 600 gr. of pure caustic soda in 1 pt. of distilled water, and filtering it through blotting paper. This mixture is poured on the surface of the glass to be gilded, and the gold reduced therefrom by one of the following re-agents. (1.) Pass a current of ordinary illuminating gas through 1 pt. of absolute alcohol for one hour, then add an equal quantity of pure glycerine diluted with its own volume of distilled water. From 10 to 15 drops of this mixture will be required to each 10 dr. of the gilding mixture. Add the re-agent a moment or two before using, and pour this on the glass surface to be gilded. In a short time the mixture will turn green, and its gold will be deposited in a bright condition on the glass. (2.) Chemically pure glycerine, mixed with the caustic soda solution previously described (equal quantities of each) may be employed instead of No. 1. (3.) Dissolve 300 gr. of glucose in 7 dr. of distilled water, and apply heat until one-third of the water has evaporated; then mix the remainder with an equal bulk of 90 per cent. alcohol. Twenty drops of this re-agent will give the gilding a reddish tinge. (4.) Dissolve 185 gr. of white sugar in 25 dr. of distilled water, add ⅓ dr. of pure nitric acid, and dilute the whole with an equal quantity of 90 per cent. alcohol; then boil the whole for a quarter of an hour. Two drachms of this mixture to each 10 dr. of the gilding mixture will be required. (5.) Employ 2½ dr. of amyl-alcohol instead of the above. This gives a special brilliancy to the gilding. (6.) An equal quantity of cane sugar brandy will produce a similar result. The glass to be gilded must be quite clean and free from spots. The solutions must also be freshly prepared, and filtered free from dust.

Making Draw-hooks.—Figs. 1 and 2 shows a locomotive engine drawbar hook and shackle of a pattern generally used. The method of making the shackle is explained on p. 67. The hooks are usually made of Bessemer steel, forged to shape under a steam hammer and stamped with a pair of blocks. If wrought-iron is used, the hooks are forged to the shape shown by A (Fig. 3), placed on a block B, which revolves by steam



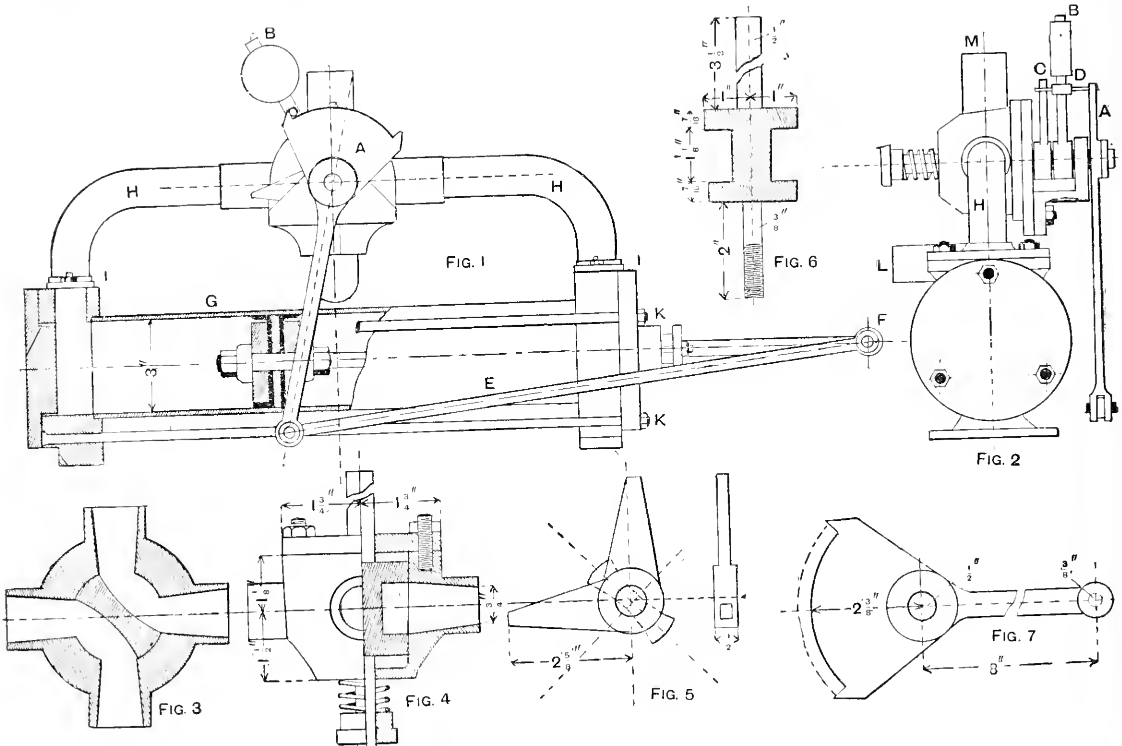
Making Draw-hooks.

or hydraulic power, and the wheel C bends the hook to the required shape, the object being to have the grain of the iron following the bend of the hook. The "Gedges" hook shown by Figs. 4 and 5 is used as a standard railway wagon coupling by most British companies, and is undoubtedly the best form of wagon hook, but it is not generally used on engines. The pin of a pin-and-shackle coupling is apt to get bent, and the coupling is then stiffened. In the two views of a Gedges wagon hook given by Figs. 4 and 5 it will be seen that the part A (Fig. 4) is flat so as to slip in the part B (Fig. 5). This does away with the pin, and gives free working to the coupling.

Making Chrome Yellow.—In making chrome yellow, 62½ parts of lead acetate should be used to 29½ parts of bichromate of potash. These salts should be dissolved separately in hot water, and the solutions allowed to become quite cold before they are mixed. Pour the bichromate solution into the lead acetate solution, stirring the whole. After mixing, allow to settle, then pour off the clear liquid; add cold water, stir well, allow to settle, and pour off the clear liquid. Repeat this washing several times, then pour the chrome yellow into a white cloth stretched on a frame; allow all the water to run off, press, and dry very gently in a clean oven or drying chamber. Paler shades may be obtained by replacing a portion of the bichromate with sulphate of soda.

Counting the Vibrations of a Clock Balance.—In testing a lever clock hairspring by counting its vibrations, fix it temporarily to the balance, and with a pair of tweezers hold the outer end of the spring in such a way as to let the bottom pivot of the balance rest on a watch glass on the board. The spring should be drawn up into a spiral, letting the weight of the balance hang upon it, so that there is hardly any weight resting on the bottom pivot. In this position a turn of the wrist will start the balance spinning, and it will continue for some time, enabling the vibrations to be counted for a full minute if necessary.

Reciprocating Water Motor.—Fig. 1 is a side elevation of a reciprocating water motor, with the back end in section showing the piston packed with the ordinary hydraulic cup leathers. Fig. 2 is an end elevation with valve gear for reversing the flow of water. For the latter purpose an ordinary four-way M the inlet. Figs. 3, 4, and 6 show the four-way cock drawn to a larger scale. Fig. 3 is a section of the cock with the web of the plug in position for making the backward stroke, as in Fig. 1, exhausting from the back. Fig. 4 is an elevation of the cock partly in section. Fig. 6 is a section of the plug, which should be carefully ground in to make it watertight, there being no gland, but only the light spring at the back to keep it to its face. The cock and plug must be cast in brass or gun-metal. Fig. 7 shows the quadrant and arm. To avoid confusion, only a few dimensions are shown. Those not given can easily be found by constructing two scales, as all the drawings are to scale, Figs. 1 and 2, not dimensioned, being one-sixth full size.



Reciprocating Water Motor.

cock is used. The plug of the cock is reversed by the quadrant A carrying the lever B past the centre, and on falling it carries with it the arm C. Fig. 5 is a side elevation of the arm, showing the position in which it must be keyed on the plug spindle. The weight on the lever B should only be sufficient to overcome the friction of the plug and gland. In Fig. 1 the piston is shown at a little more than half of its backward stroke. The quadrant A has commenced to take over the lever B and weight, and on getting to the centre line will take with it the arm C (Fig. 2), and on passing the centre line the quadrant and arm will fall together, throwing over the plug. A piece of india-rubber to form a cushion to break the fall of the lever must be fixed on each side of the bracket carrying the plug spindle. The quadrant is worked by the rod E (Fig. 1) from the cross-head F on the piston rod. The working cylinder G is a piece of 3-in. drawn brass tube 16 in. long. The ends are two iron castings, with a port 1 in. in diameter in each. The back end has a cover, and the front carries a stuffing box, as shown in Fig. 1. The feet for bolting down the motor are cast with the ends. The pipes H, of 1-in. wrought iron, are fixed to the cylinder ends with flanges I. The ends and brass cylinder are bolted together by three stay bolts K, but only two are shown. At the back end the heads are countersunk to allow the cover to be bolted on. At the front the ends are taken through, all being drawn tight together by the nuts. L is the exhaust pipe, and

Burnishing Photographs.—Below are given instructions on burnishing photographs with a bar burnisher. First examine the bar to see that it is free from scratches. Unscrew the nut and remove the slab holding the plated bar. If the bar shows any scratches running across it, rub from end to end with a piece of fine emery cloth glued flat to a bar of wood till the scratches disappear. Dust carefully all the parts and replace the slab. Now light the stove beneath the slab. Moisture on the slab must be wiped away till it ceases to appear. A lubricator should be made up by dissolving about 20 gr. of castile soap in 2 oz. of methylated spirit. The lubricator is rubbed over the face of the print and allowed to dry spontaneously. Some workers prefer to rub the soap over dry with a silk handkerchief. Wet the tip of the finger and just touch the end of the bar. If it hisses it is warm enough. A trial print is now passed through the burnisher, and if it is neither scratched nor scorched, but shows a good polish, the rest of the prints may be burnished. The print must be passed through at one sweep; a stoppage means a line or dent across the print. In passing the print through the burnisher, lift the near part above the opening; this will cause the print to curl slightly outwards, but as it curls it will lie flat. Prints should go through the burnisher lengthwise. The great disadvantage in using a bar burnisher is its tendency to scratch, although this trouble is minimised by careful use. For this reason "enamellers," such as the "Quadruplex Enameller," are generally used. In these machines the print passes between two plated rollers heated from below. A "lubricator" is not needed, and scratches are impossible.

French Polishing Decorated Woodwork. — To French polish woodwork the surface of which has been printed upon, or has had prints transferred to it, the method of procedure may be as follows. Dissolve 1 oz. of best isinglass in 1 pt. of water, strain through flannel or fine muslin, and set aside till cold, when the solution should be of the consistency of jelly; if not, add isinglass. When the printing is quite dry, slightly warm the jelly so that it will flow, and brush it over the article in one direction only; use a camel-hair brush, and work from end to end. Set aside till dry, then go over the article again from side to side; this will ensure every part being covered. When the work is quite dry, polish may be freely applied. Transparent polish made from white lac should be used.

Preventing Moisture Dropping from Glass Roof. —One way of preventing condensed moisture from dropping from a glass roof would be to fix small gutters to the sides of the bars, as shown by the sections A (Figs. 1 and 2), and mitre them to a similar gutter running along the bottom rail of the skylight, as shown at A (Fig. 3). To allow the moisture to escape into the gutter D, a hole B to C (Fig. 3) having an outlet in the throating at C should be bored between every two bars. By having the rebate of each alternate bar about ⅛ in. deeper, the glass could be glazed a little sloping as indicated at Figs. 1 and 2; this would cause the moisture to flow to one side, and the small gutters A need only be fixed to each bar having the deeper rebate, as is made quite clear by Fig. 2.

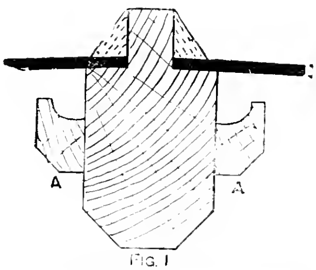


FIG. 1

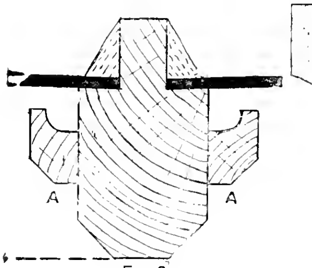


FIG. 2

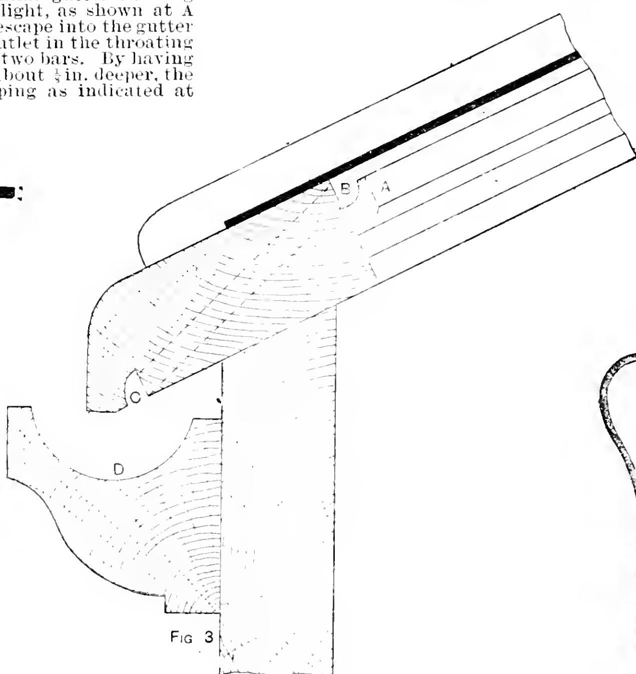


FIG 3

Preventing Moisture Dropping from Glass Roof.

Reed Hook for American Organs.

The Preservation of American Organs.—On the arrival by rail of an American organ it should be unpacked carefully. Before use it should be thoroughly cleansed, inside and out, from dust, which will sometimes get into the organ, especially if the top portion is taken off to enable the instrument to be packed in a small case. The minutest particle of dust may check the vibration of some of the smaller reeds; therefore, if a reed does not sound, or gives out a false note, use a reed hook as shown by the sketch. One should be put into the instrument, or a good substitute is a button hook with a long shank. The stops being drawn and the swells lifted with the hook, pull the reed frame out and give it a smart tap to jar out the foreign substance. The reeds belonging to the *principal* and *flute* stops are in front. To reach them, first unscrew and remove the key slip, a piece of fretwood directly under the keys in front; then the stops being drawn and the swell cover thus lifted, the ends of the reed frames will be visible. The *dulciana* and *diapason* reeds are at the back of the reed board, and are readily accessible after the removal of the portion of the case at the back that is generally secured by buttons or screws. The *sub-bass* reeds are in sight in a separate box on the top of the wind-chest. When drawing a reed, be careful not to insert the hook so far as to catch the reed tongue. A notch will be found in the reed frame at the front or sight end to receive the turned-down portion of the hook. The rattling of reeds is often caused by an uneven floor; damp may also cause the reed cell to swell, thus pinching the reed frame and preventing the tongue vibrating freely; or a false tone may be caused by the reed frame having jarred out a little. To remedy, insert the reed hook in the notch of the reed frame, move it backwards and forwards a few times, and finally press it home well. Should this treatment not prove sufficient, ease the edge of the reed frame with a smooth file. Other causes of faulty sounds are loose objects, such as screws, hat pins, nails, and loose keys, hinge joints, or panels. If the lock gives trouble in this way, remove it and hammer up the sides a little. Wedge up any loose panels, insert a piece of cloth under any spring that may be touching direct on the wood of the swells, and tighten all loose portions that vibrate or jar in unison with any particular note or chord. Should creaking occur in the blow pedals, lubricate with tallow or blacklead in preference to oil. If a key sticks or becomes sluggish in its movements, try moving it up and down gently rather than attempting to take the action apart. Put briefly, each key rests upon a small, perpendicular, wooden pin, generally of cedar; each pin stands on a valve, and each valve is held in position by two springs. If the key falls below its proper level and is otherwise free in its movements, not binding on the guide pins, the valve may not act by reason of a spring slipping out of place; or it may be prevented from closing by some foreign substance having lodged upon it, which may sometimes be removed by vigorous blowing. Often these pins swell with moisture and cannot then work freely through the guide holes. Blacklead will be found a suitable lubricant. In instruments containing more than two sets of reeds, the taking apart of the action with the object of removing the keys is not advised. The cabinet portion of the case should be treated in a similar manner to high-class furniture, the polished surface being frequently freshened. The use of wax polish is not advised unless it is applied thinly and frequently; most of the polish revivers may be used with good effect, especially Ronuk, which merely requires diluting with turpentine for dull finished cases. A good reviver is made of lime water, linseed oil, and turpentine in equal parts; mix the first two together thoroughly, then add the turpentine and shake before using. Apply with wadding, a little at a time, and rub well; wipe off with rag, and finish with a swab of clean soft rag slightly damped with methylated spirit. Apply this damp pad only lightly at first, and add a little pressure as the methylated spirit dries out.

Making Prussian Blue and Vermilionette.—Prussian blue is made by adding a solution of ferrocyanide of potassium (yellow prussiate) to a solution of ferric chloride, or by adding the former to a solution of ferrous sulphate (green vitriol) and afterwards with nitric acid or other oxidising agent. The precipitate is allowed to settle, washed several times with water by decantation, collected in filter bags, pressed, and slowly dried. Vermilionettes are made by mixing orange lead and barytes with water, then adding eosin and lead acetate until the colouring matter is entirely precipitated upon the barytes and orange lead. The pigment is finished as in the case of Prussian blue. The colours are made in large wooden vats; filter presses and drying stoves are required also.

Drilling Hard Steel Watch Pinions.—Ready made drills are generally too soft to cut watch pinions; they have to be rehardened by heating the blades only in a flame and rapidly withdrawing them with a sudden jerk. This is called "flirting" them, and the sudden cooling in the air effects the hardening. Sharpen them before using, and lubricate with turps. Occasionally a pinion is found too hard to be drilled even by this method; it then has to be lowered to a blue temper.

Electro-plating Aluminium.—For copper-plating aluminium, the bath may be cyanide of copper, 6 parts (by weight); cyanide of potassium, 9 parts; phosphate of soda, 9 parts; and water, 100 parts. For gold-plating, chloride of gold, 2 parts; cyanide of potassium, 2 parts; phosphate of soda, 2 parts; and water, 100 parts. For nickel-plating, chloride of nickel, 7 parts; phosphate of soda, 7 parts; and water, 100 parts. For silver-plating, nitrate of silver, 2 parts; cyanide of potassium, 4 parts; phosphate of soda, 4 parts; and water, 100 parts. Keep the bath whilst plating at a temperature of from 140° to 158° F. (60° to 70° C.). For the anode, use a strip of the metal which is to be deposited. The baths given above are on the authority of Lanseigne and Leblanc.

Medicated Soaps.—It is obvious that of primary importance in making medicinal or medicated soaps is the employment of a pure base. However effectual as a remedy for skin diseases the medicinal soap might be, the presence of an impure and alkaline base is almost sure to cause roughness and desquamation (the formation of scale) on the skin. Medicinal soaps of good quality are prepared with Voiry's plain cocoanut oil paste soap as a base. This is made as follows. 12 parts by weight of cocoanut oil are boiled in a porcelain dish with 8 parts of soda lye (10° B.); to the cream thus obtained, add 5 parts of soda lye (20° B.), and arrest the boiling when a sample placed on a cold body becomes solid. Add a quantity of distilled water, bring again to the boil, and add 5 parts of common salt. The soap is separated by decantation after cooling, cleansed by washing twice in a 20 per cent. solution of ordinary salt, and afterwards in cold distilled water. The excess of water is squeezed out, and a plain paste soap is the product. The first medicinal soaps made contained tar, and were neither pleasant looking nor agreeable to use, but for all that they were useful and effective. Recipes for tar soaps are: (1) Beat together 1 part of tar, 2 parts of liquor potassa, and 2 parts of soap in shavings. (2) Make up in the usual way 4 lb. of cocoanut oil, 2 lb. of tallow, 1 lb. of juniper tar, and 3 lb. of soda lye (40° B.). For a vaseline tar soap, saponify 40 lb. of cocoanut oil and 6 lb. of tar with 22 lb. of lye (40° B.). Melt 4 lb. of yellow vaseline, and stir into it the soap, with the addition of 4 lb. of lukewarm water. (3) Rub up 1 part by weight of tar with 9 parts of Voiry's paste soap. Possessing the good qualities of tar, and but few of its pronounced disadvantages for use in medicinal soap, is carbolic acid. A soap containing as much as 25 per cent. of this can be used for the hands, but is not suitable for general use. Even carbolic soap, though an improvement on tar soap, is not an ideal material, as it has a strong odour. Recipes for carbolic soaps are: (1) Melt 20 lb. of half-palm soap and add 1 lb. of starch, and mix thoroughly; then add 1 oz. of carbolic acid in crystals, 2 oz. of oil of lavender, and 1 oz. of oil of cloves. (2) Incorporate in a warm mortar 75 parts of powdered stearin soap with 25 parts of pure carbolic acid, and press the product into tablets. (3) Melt 150 parts of fresh cocoanut oil soap, and add 10 parts of a solution of alcohol, 6 parts of carbolic acid, 2 parts of caustic potash, and 1 part of oil of lemon. Stir thoroughly, and pour into moulds. (4) Dissolve 2 parts by weight of white carbolic acid in 1 part of 90 per cent. alcohol, and gradually rub up with 38 parts of Voiry's paste soap. Salol enters into the composition of many soaps, and especially into shaving soaps, suggested as a remedy for and preventive of sycosis parasitaria, a disease contracted at barbers' shops from razors and accessories. In making salol shaving soap the base is prepared first. 1 lb. of beef suet is melted with ½ lb. of cocoanut oil and allowed to cool to 120° F.; after adding 11 oz. of 18 per cent. caustic soda solution and 2½ oz. of 21 per cent. caustic potash solution, the mass is stirred at a gentle heat for half an hour, or until it is homogeneous. Perfume is added consisting of 40 minims of oil of caraway, 50 minims of oil of bergamot, 30 minims of oil of lavender, 20 minims of oil of thyme, and 6 drops of essence of mirbane. While the mass is still warm, 1 oz. of finely powdered salol is added, and the whole is heated to 113° F., at which temperature the antiseptic melts; it is stirred thoroughly the while. When cold the soap is cut up as desired, dried partially in the open air, and, for preference, wrapped in tinfoil. To make a salol soap powder, mix together 35 oz. of finely powdered stearin soap, 1 grain of coumarin, 5 drops of oil of bergamot, and 2 drops of oil of winter green; mix 2 lb. of this base with 1 oz. of finely powdered salol. Mercurial soap is made by saponifying mercurial ointment; thus 10 oz. of mercury are mixed thoroughly with 2 oz. of mercurial ointment until the globules are not visible with a lens, and then 18 oz. of powdered soap and 2 oz. of lard are added. Do not place mercurial soaps in contact with metals. Other recipes for mercurial soaps are: (1) Beat up to a uniform mass in a mortar 1 drachm of corrosive sublimate, 1 fluid ounce of rectified spirit, and 4 oz. of powdered white castile soap; add a few drops of attar of roses or a mixture of the oils of cassia and bitter almonds. (2) Dissolve 1 part by weight of sublimate in 16 parts of alcohol, filter, and rub up with sufficient of Voiry's paste-soap. (3) Beat up into a smooth mass 1 lb. of white castile soap and ⅛ oz. of protochloride of mercury dissolved in 4 oz. of alcohol. Ichthyol soap is used in the treatment of eczema and rosacea, and reduces redness of the skin; it may contain as much as 5 per cent. of the sodium sulphichthyolate. Boracic soap containing borax or boric acid has many desirable qualities; the soft kinds are made thus: (1) Add a borax solution to the ordinary soft-soap ingredients either before or after manufacture. (2) Dissolve by heat any ordinary soft soap in a borax solution, and when cold thoroughly incorporate the two. (3) Either by beating up in a mortar or by the aid of gentle heat, incorporate 1 oz. of borax with 1 lb. of new Windsor soap. (4) Add 10 lb. of soda lye (15° B.) to 10 lb. of molten white fat till a clear liquid is formed, and then add 6 lb. of potash lye (10° B.) and 1½ lb. of borax solution to produce a semi-solid translucent paste. (5) For a harder soap rub up in a mortar equal parts of sodium borate and Voiry's paste soap and press to the shape required. Sulphur is made up into many soaps, the best of which contain about 10 per cent. of very finely divided sulphur, and are perfumed, as when used alone sulphur gives soap a rather unpleasant smell. Various combinations of tar, naphthol, iodides, etc., with sulphur are employed also. Recipes for sulphur soaps are: (1) Beat to a smooth mass in a mortar 8 oz. of freshly made white curd or castile soap, 1 oz. of levigated flowers of sulphur, 1 fluid oz. of rectified spirit, tinted by infusing alkanet in it, and add a few drops of attar of roses. (2) For camphorated sulphur soap, dissolve 4 parts (by weight) of camphor in 300 parts of molten cocoanut oil, saponify with 150 parts of soda lye (38° B.), and add 25 parts of potassium sulphate dissolved in 13 parts of water. (3) Rub up in a mortar 1 part (by weight) of sulphur with 9 parts of Voiry's paste soap and press to shape. Thiosavonal is a new kind of soft sulphur soap (soluble in water), in the preparation of which sulphurised oils are used. Grube's formula is: Make fluid the thick thio oil by adding alcohol, and stir in an equal bulk of potash lye, also thinned with alcohol. The addition of large quantities of potash lye at one time produces separation of the sulphur, but the danger lessens towards the end of saponification. At last a small excess of potash lye is added. If the liquid is quite clear, and if a sample is soluble both in water and in alcohol, all the thiosebacic acid has saponified. Neutralise the excess of alkali by adding volatile fatty acid and free the resultant soap solution from alcohol in a steam bath, and boil down to the consistency of soft salve, occasionally testing for neutrality; 85 parts of this are mixed with 15 parts of glycerine. A liquid thiosavonal or sulphur soap may be made by boiling down the soap solution as obtained above to the consistency of syrup instead of to a salve, 88 parts then being mixed with 12 parts of glycerine.

Filter for Bleaching Fluid.—An apparatus for filtering a chloride of lime bleaching fluid may be made easily. In the tube of a large glass funnel fix a short piece of the stem of a clay tobacco pipe; on the top of this pile a few pieces of broken tobacco pipe, and cover them with a layer of fine silver sand. This arrangement can be used as a filtering bed for the bleaching fluid; when the bed becomes clogged and does not act properly, wash out the funnel and refill it with fresh material in the manner already described. Another method of clearing bleaching fluid is to allow it to settle in a tall vessel, and syphon off the clear liquid. A syphon is easily made by bending a pipe, or one may be purchased very cheaply.

Illuminating Powers of Various Lights for Magic Lanterns.—The following is an account of the work of M. Molteni on the projection value of various illuminants. The measurements were made with an ordinary lantern, the stage of which carried an opaque card in which was cut an aperture 0·7 centimetre square, while the distance of the lantern from the screen was such that each side of the square on the screen measured 1 metre. The screen was replaced by a disc of paper, the opposite side being illuminated by a standard lamp burning 12 grammes of oil per hour. The distance of the lamp was varied in order that equality of illumination might be obtained on the screen, and the photometric values of the light were determined from the distance of the lamp:—Multiple wick lamp, 1·00. Incandescent gas burner No. 2, no reflector, 1·00. Acetylene, with no reflector: No. 1 burner, 1·06; No. 2 burner, 1·10; No. 3 burner, 3·20; No. 4 burner, 4·10; No. 5 burner, 4·50. Limelight: alcohol and oxygen, 5·80; oxy-hydrogen, 16·60. Electric incandescent lamp, 32 candle-power, 0·68; 50 candle-power, vertical, 0·93; 50 candle-power, horizontal, 0·93; focus 100, 3·82. Arc lamps, 7 amperes: 39·03; 10 amperes, 75·61; 12 amperes, 86·50; 15 amperes, 117·61; 20 amperes, 160·80. The candle-powers of Welsbach incandescent burners are given on p. 297. It may be mentioned that a duplex oil-lamp will give a light of from twenty-eight to thirty candles.

Winding Cotton on Reels.—The method adopted by thread manufacturers in winding cotton on ordinary reels is to use a spooling machine. Wield's spooling machine has been very successful, and winds a number of spools simultaneously. Each bobbin is fixed between two conical spindles that are driven by gearing. The cotton is guided by steel guides, threaded to correspond with the pitch of the screws formed by the thread on the spool. These guides have a reciprocal horizontal traverse equal to the length of the spool, and gradually increasing as the surface upon which the thread is wound increases; this increase arises from the bevel on the flanges of the spools. This movement is obtained from a fine-pitched screw on a roller, with which two half nuts alternately engage, one on each side of its centre. As these are thrown into gear, they give a traverse to the guide rail in each direction, and the period of engagement determines the length of the traverse. In winding, the reels fall into position from a trough or reservoir on to a plate, which rises so as to bring the spool between the open spindles. These close, immediately begin to revolve, and the guide rail begins its horizontal motions. The thread is passed through a spring tension clip, which holds it tight. When the required length of thread is wound on, winding automatically ceases, and a knife, placed in an arm, descends and cuts a nick in one end of each spool; the thread is drawn into this nick and over another knife and cut. The spindles then open, and the spools fall down a shoot. Another set of spools is then fed as described, and the ends of the thread are so held that, immediately the spindles begin to revolve, the ends are drawn on to the spools. Twenty-six gross of spools, each spool containing 200 yd. of thread, can be wound by a machine in ten and a-half hours.

Removing Nickel from Cycles.—Nickel may be removed from cycle parts by steeping them for a short time in commercial sulphuric acid, to which is added, from time to time, a small quantity of nitric acid. However, owing to the corrosive nature and fumes of the acid, the nickel is generally removed with emery bobs, the work being polished ready for plating at the same time.

Blackening Carriage Ironwork.—For blackening carriage ironwork, japan of two kinds is employed; one kind is known as baking-japan, and is hardened by heat, whilst the other dries in the open air and at ordinary temperatures. Baking-japan is made by melting asphaltum, removing it from the fire, and stirring in oil of turpentine; its effects are permanent, and it does not need to be varnished; such a protection is necessary for ordinary air-drying japans. Small work that has become dull by storing is dipped into the japan, the surplus is drained off, and the work put into an oven, where it is maintained at a temperature of several hundred degrees Fahrenheit for some hours. Fine work should have a coat of dead black colour first as the japan is transparent, and in this case may be applied with a brush. The air-drying japan is a jet black solution of asphaltum in turpentine; it is brushed on and dries quickly, but does not become so hard as the baked japan, but it may be recommended for parts which are not handled much. An alternative method of blackening iron is to employ ivory black ground in brown japan. This is made up to the consistency of butter and is thinned with turpentine, being applied then with a small camel-hair brush. It dries in a few minutes, and should then be varnished. When work is wanted in a hurry, quick-drying French shellac varnish may be used. For cheap work, lamp-black and shellac varnish will do admirably, but asphaltum, of course, is to be preferred. Japan may be applied to small articles by means of 1-in. flat badger bass brushes having tin ferrules. When working, it should be borne in mind that all japans are partly transparent, and that when one coat over a bright metallic surface does not cover satisfactorily, a second coating must be applied; care should be taken that the first coat of japan is quite dry before applying the next, or rough, dull work will result.

Destroying Worms in Furniture.—The furniture containing the worm or insect holes must be removed into the open air, or into a well-ventilated room where there is neither fire nor artificial light. Dissolve 4 oz. of albo-carbon in 1 pt. of benzoline, and paint the furniture with the solution; or, if the furniture is full of small holes, inject the solution into the holes with a syringe. Insect life cannot survive a proper and thorough application of this solution. If the benzoline is of good quality, even such a delicate fabric as silk is not injured by it. Another method is to saturate the wood with ordinary petroleum; for very bad cases, powdered quicklime made into a paste with liquor ammonia can be used. Worms freely attack unsound timber, especially if such timber is used for inside fittings; and furniture kept or stored in damp rooms, or left in contact with other worm-eaten furniture or woodwork, is sooner or later sure to be attacked by worms. Preventive measures, therefore, are largely in the hands of the manufacturer and the user of furniture. Periodical examination of suspected woodwork, and the timely application of the remedies given above, are the best preventive measures that can be adopted.

Sharpening Wood-carving Tools.—Wood-carving tools differ from the ordinary carpenter's chisels and gouges by being bevelled on both the inner and outer edge. The outside bevel of the curved tools is just sufficient to give a clean edge, and is produced by working the gouges backward and forward along the length of the oilstone, and at the same time giving a sweep of the wrist to bring the whole width of the tool in contact with the stone. This is continued until a regular burr or wire-edge is formed, and a polished band about ⅛ in. wide is seen following the edge of the tool. For producing the inside bevel, slips or stones exactly fitting the inner curve of each tool are required. These slips may be held in the hand, or fixed in a frame or vice. A backward and forward movement of the tool soon produces the desired bevel. When a regular burr is formed on the cutting edge, that is, when both bevels meet, the work of the slip is finished. A strop, covered with a mixture of grease and emery powder, is next used on both bevels in order to remove the burr and give a clean edge. A V- or wedge-shaped edge is produced, which facilitates the withdrawal of the tools from the wood after every blow. If the two bevels are not properly produced the tool will snap from impact with the wood at every attempt to withdraw it. This often results, too, if the V of the bevels is too slender or elongated.

Fixing Transfers on Metal and Wood.—The groundwork of wooden or metallic articles to be decorated with printed transfers must in all cases be first prepared. Thus, metals are generally japanned or varnished, woodwork being chiefly French polished. With a camel-hair brush, apply to the printed or face side of the design a thin even coat of copal or carriage varnish reduced with turpentine; set aside for ten minutes, or until the varnish becomes sticky or nearly dry, then place the picture, face downwards, on the article to be decorated. Press the transfer well down to drive out all air bubbles, starting at the centre and pressing towards the edges. It is essential that the transfer shall be in close contact with the surface at every part. A rubber roller (a squeegee, as used for mounting photographs) is very useful for large prints. Having pressed the transfer well down, set it aside until the varnish is quite dry; the longer the time allowed for drying the better, especially on metals, though with careful handling the picture may be taken off in half an hour. With a sponge and slightly warm water, damp the paper and press it down again, then saturate more freely. Now lift up the transfer at one corner and carefully peel off; then wipe over the print with clean water. Soak up all moisture by gently dabbing with a clean damp chamois leather. When the design is quite dry, it may be varnished or polished. In transferring designs to glass or porcelain, best gelatine dissolved in hot water may be used as an adhesive; and for painted furniture, mail-carts, and perambulators, that are finished by two or more coats of varnish, the design may be transferred direct on the first coat of the varnish when this is tacky or nearly dry. In this case it is not necessary to coat the face of the design.

Polishing Ox Horns.—Here are instructions on polishing a pair of ox horns. Remove all roughness from the horns by means of a spokeshave or rasp, followed by a scraper, a knife, the side of a chisel, a wood scraper, etc. Then go over them with sand-paper or glasspaper, using coarse paper first, then finer, and the finest last. Pumice powder should next be used, followed by the dust removed from the horn; these can be applied on a rag dipped in oil. Then apply putty powder in the same way, followed by whiting moistened with vinegar. Now use dry cloths, commencing with a coarse one and finishing with a soft one, or even tissue paper. Lastly, use the bare palm of the hand. In applying each of the above-mentioned substances plenty of "elbow grease" must be used, and the work must be very carefully dusted between successive stages to remove any trace of coarse grit. The use of a lathe with calico mops, etc., if procurable, will save time and labour and will give a better result.

Cleaning Acetylene Gas Burners.—Acetylene burners are most conveniently cleaned with a very fine needle fixed firmly in a handle; but a piece of very fine wire of a stiffness equal to a needle, if obtainable, will do just as well. As a rule, fine wires are soft, and a stiff wire of the required fineness could not be so easily obtained as a fine needle.

Cramping Picture Frames.—Of the dozens of methods of cramping picture frames the following has been recommended as being cheap and efficient. After shooting the joints, glue them, and place the frame on the bench. With a piece of cord bind the frame three times round the outside; then lift the cord from the edge of the moulding, and between the cord and the edge of the frame insert eight wood blocks, $\frac{3}{4}$ in. or 1 in. square and 3 in. long; see Fig. 1. Now with thumb and finger press the mitres into position, so that the members intersect properly, and then draw the blocks towards the mitres, as in Fig. 2; this cramps the whole. When the frame is dry, remove the cramp, and carefully brad the mitres, boring the holes first with a bradawl, with the frame flat on the bench.

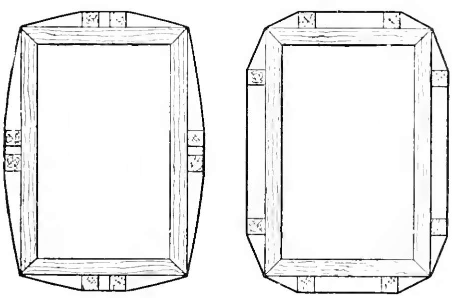


FIG. 1 FIG. 2

Cramping Picture Frames.

Poising a Watch Balance.—To poise a watch balance, first remove the hairspring and brush the balance and pivots clean. Then place the balance on the parallel edges of a poising tool or in a pair of callipers and allow it to settle. It will always rest with the heavy part downwards. Gentle tapping of the callipers assists it to settle. With a plain balance, lighten the heavy part by filing the inner under edge of the rim; with a balance having screws, reduce a screw lightly or add washers to the light screws.

Laying a Tiled Hearth.—A trowel, float, straight-edge, and a pair of carpenter's pincers will be required. First mix cement and sand and make the hearth quite level and at a depth that will allow of the tiles, when laid, lining with the floor. This would make the cement hearth about $\frac{1}{2}$ in below the floor level, according to the thickness of the tile. Lay the tiles while the cement hearth is still moist. Commence at the front edge and work back towards the grate, using the straightedge occasionally to see that all the tiles are quite level. See that the division lines between the tiles are kept straight and true, as tiles sometimes differ in size a trifle. Try and slip the edges of the tiles under the grate; if this is not possible, and they must be cut, use a pair of carpenter's pincers. Nip pieces off until the tile is the desired size and shape. With a chisel there is danger of breaking the tiles and the cutting takes much longer; however, tiles are chiselled as described on p. 244. Previous to laying the tiles, they should be well soaked in a pail of water placed at the side of the tile layer, and taken from this direct to the hearth. Some lay the tiles without cement, and just float a little (as thin as milk) over afterwards to run in the joints. It is better to have a little cement, as thick as cream, on a board and just rub the bottom of the tile on this as it passes from the pail to the hearth. This applies to 4-in. tiles and smaller. For 6-in. tiles, a thin layer of the cement might be put on with a trowel. Cement should not be placed on the edges of the tiles; it makes an ugly job. (See also p. 244.)

Re-varnishing a Jaunting Car.—Here are instructions on treating a jaunting car the varnish of which is very much worn. Scrape off all the old varnish to the wood, then glasspaper down, working with the grain of the wood. The ironwork should be scraped with an old plane-iron or knife, and then glasspapered. To stain the body darker than the natural wood, give a coat of burnt umber ground in turps, working it well into the grain with a stiff brush, and wiping off the surplus on the face of the wood. When the stain is thoroughly dry, lightly glasspaper over with the grain of the wood, to remove any small parts that may have risen, and after dusting off, give a coat of pale gold size to which about an eighth part of raw linseed oil has been added. This, when hard, is lightly glasspapered off, and another coat of size with rather less oil is given. This, when dry, is treated the same as the first coat, and a coat of varnish and gold size is applied. Before putting on the next coat, the one just given will require flatting. This is done with a pad of cloth and ground pumice-stone, using plenty of water to prevent scratching. When the surface has been gone over, well wash with water to remove every particle of dust from the quirks and corners, then give a coat of carriage varnish known as under-coating. Let this stand for a couple of days to get hard, then flat down as before, and give a full coat of pale carriage varnish. This should be sufficient for an ordinary job, but for good work another coat should be given. The ironwork should have two coats of light lead colour and one coat much darker, with light glasspapering between the coats to remove nibs, etc. Then give a coat of dead black, one coat of shiny black, and one or two coats of black japan, the whole being got up with the body so as to be included in the varnishing when the body is done. The work should be done in a dry place, free from draughts, and kept at a temperature of about 75° F.

Copying Printed Pictures by Photographic Transfer.—The process of transferring printed pictures photographically is as follows. Place any printed picture, face downwards, on a sensitive photographic dry plate, expose freely to the light, and pass a warm iron over both plate and picture. The heat and the pressure will transfer, more or less successfully, the printed picture from the paper to the plate. Then immerse the plate in a bath composed of a saturated solution of ferrous sulphate 1 part and a saturated solution of potassium oxalate 3 parts. This bath will blacken all those parts of the plate that are not covered with the greasy printing ink. Rinse the plate in water; after which the plate must be rubbed over with a weak solution of ammonia and then placed in the fixing bath. From the negative thus obtained any number of copies may be made. Where only one copy is required the fixing is done first.

Covering Roofs with Oak Shingling.—Oak shingles as a roof covering have a good appearance after they have become somewhat weathered. They are made from the ordinary rended oak pales, and must be riven out of as straight-grained oak as can be obtained: in no case must they be sawn. Shingles that are of fairly equal thickness, and have little or no sap, should be chosen. Pales 4 ft. 6 in. or 6 ft. in length may be most economically cut up into shingles 18 in. long, which is the usual length, their width being from 3 in. to 5 in. It is not advisable to give them a greater width than 5 in., or they will be likely to curl excessively. They are usually about 1 in. in thickness at one end, and taper off towards the other. The roof in preparation for the shingling must first be close-boarded. The shingling is then started with an eaves course of shingles from 10 in. to 12 in. long, and from this the work proceeds in the same manner as that of ordinary roof slating, with a 6-in. lap. Each shingle has two nails driven through it at, say 11 in. from the foot of the shingle, so that each shingle is eventually held by four nails, the nails being machine wrought, about $1\frac{1}{4}$ in. long, and with rose heads. Boring is not required, for if the shingles are wetted a little they will be easily pierced by the nails and there will be no danger of their splitting. At the hips, the shingles are mitred with a shingling axe over a secret gutter lined with lead. The cost of shingling is more than that of slating, but it is greatly superior in stability; and if the work is properly executed, repairs are almost wholly unnecessary. Winter-felled shingles will last fifty years or more.

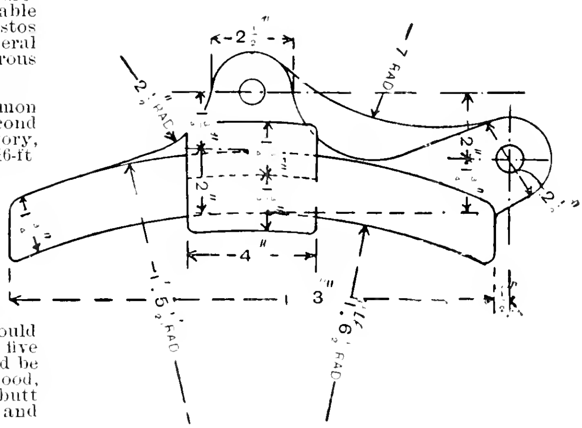
Particulars of Asbestos.—Asbestos, a fibrous form of amphibole or hornblende, is composed principally of silica, magnesia, lime, and oxide of iron. Sometimes asbestos is a compact substance, the fibres being stiff and brittle, whilst in other samples the fibres are easily separable, being then elastic and flexible; the fibres may be reduced to a powder which is soft to the touch. In colour, asbestos varies, and is found in whitish shades of green and grey, passing into brown, red, or black. Asbestos is nearly incombustible, and being a very low conductor of heat, finds its application in almost every department of industry. It is mined in Siberia, Switzerland, Spain, Italy, the United Kingdom, and in many parts of Canada and the United States. On being detached from the surrounding rock by blasting, the blocks of asbestos are examined, pounded in such a manner as not to break the fibres, and these are then sorted into different lengths. The fibres, which in good specimens may be 20in. long, are treated in much the same way as are ordinary textile threads; asbestos cannot, however, be felted, and the process of concentration through which, in consequence, the fibres must pass renders the manufacture of asbestos tissues very difficult. Rock-cork asbestos resembles vegetable cork, is soft and easily cut, and is sufficiently light to float on water. Rock-leather or mountain-leather and rock-wood or mountain-wood resemble rock-cork, but are heavier; rock-wood has somewhat the structure of wood. Other varieties are fossil-paper and fossil-flax, which have respectively a paper-like and a flax-like texture. Amianthus asbestos is a very superior kind, and is capable of being woven into the finest of tissues. Blue asbestos is more correctly termed crocidolite, which is a mineral composed of silica, iron, and sodium; it has a fibrous structure and a delicate blue colour.

Dimensions of Fishing Rods.—For an 18-ft. salmon rod, the top should be of lancewood, the second and third joints of greenheart, the butt of hickory, and the ferrules $\frac{3}{8}$ in., $\frac{1}{2}$ in., and $\frac{5}{8}$ in. For a 16-ft salmon fly-rod, the top should be of greenheart or lancewood, the second joint of lancewood, the third joint and the butt of hickory, and the ferrules $\frac{5}{16}$ in., $\frac{7}{16}$ in., and $\frac{9}{16}$ in. For a sea-trout rod, make the top of lancewood, and the other parts of bamboo or red deal; the ferrules should be $\frac{3}{8}$ in., $\frac{1}{2}$ in., and $\frac{5}{8}$ in. For a trout rod for fly fishing, the top should be half greenheart and half lancewood, the second joint lancewood, and the butt greenheart or hickory; or the rod may be made entirely of split cane; the ferrules should be $\frac{1}{4}$ in. and $\frac{7}{16}$ in. A cycle rod may be made in five parts, each part about 2ft. 5in. long; the top should be of split cane or lancewood, the second joint lancewood, the third and fourth joints greenheart, and the butt hickory; the ferrules should be $\frac{3}{16}$ in., $\frac{5}{16}$ in., $\frac{3}{8}$ in., and $\frac{1}{2}$ in., and the winch fittings $1\frac{1}{8}$ in.

Enamelling Cycle.—Enamelling processes are of two kinds, either cold enamelling or stoving. If the enamel is not to be stoved, the metal must be smoothed as much as possible with the file and with a fine emery cloth. A very thin coat of enamel should then be applied, and after it is dry it should be smoothed with the finest glasspaper; two more coats may then be given, each coat being smoothed with glasspaper. Up to this stage the object has been to obtain a perfectly uniform surface and not to produce a glossy coat. The last coat may consist either of the best copal varnish or of the enamel paint, and it should dry with a lustre. If stoving is employed, a black stoving enamel must be used; the method of applying the enamel is practically the same in both cases.

Making Cushions for Pony Cart.—For best work pony cart cushions should be covered with all-wool cloth; for hard wear, a French carpet or Oxford cord may be found suitable; whilst American cloth is used for the cheaper kinds of cushions. An ordinary square cushion is made up of a top, bottom, two sides, and two ends, and is about 3in. deep. In marking out the size, allowance must be made for the seams at the top and bottom corners. Before sewing the sides and top together, make some seaming lace, which is sold without the cord worked in; the seaming cord is tacked into the lace, the tag of which is worked in when sewing the cushion together, so that the pipe formed by the cord covers the seam. The cushion is made wrong side out, and is stitched round at the top and nearly round at the bottom edge, a space of about 6in. being left undone for stuffing. Turn the cushion right side out, and fasten it, bottom downwards, on a bench with a tab and garnish awl or nail at each corner, and proceed with the stuffing. For best work, good white curled horsehair is used; and for inferior work, cotton waste or flock, alva, or cocoa fibre. Practice is required to get the stuffing fairly even and equal, for which purpose a stick, about 2ft. 6in. long by 1in. wide and $\frac{3}{8}$in. thick, tapered off to $\frac{1}{4}$in. thick at the tip, is used; a small notch should be cut in the top of the stick with which to carry along the hair. After the cushion is filled, sew up the space in the sides and set it all well down with the palm of the hand, striking the cushion smartly all over. To put in the buttons or tufts, mark the position of each button with a compass and piece of chalk on the top of the cushion; string sufficient buttons for the job, leaving the strings long enough to handle and tie up on the bottom; put the strings through the eye of a quilting needle, and push the latter through square from the top; make a hole across some buttons on the inner or cloth side, lace the ends of the strings which came through the cushion through these buttons for the bottom, and tie down tight and close, so that the knot of the twine is hidden beneath the button. In cutting off the ends, be careful not to cut the material or the twine higher up. Treat the remaining buttons in a similar manner, taking care to tie them all down alike. The tools required are scissors, needles for sewing, a quilting needle, a stuffing stick, a 3-ft. rule or tape measure, and a knife. Cloth is supplied in 56-in. and 60-in. widths, French carpets in 36-in. widths.

Setting Out Railway Wagon Brake Blocks.—The illustration shows the various radii employed in setting out a brake block for a standard railway wagon. The diameter of the wheel is 3ft. 1in., and the radius for the sole of the brake block is half the diameter of the wheel—



Setting Out Railway Wagon Brake Blocks.

that is, 1ft. $6\frac{1}{2}$in., as it is the rule to set out the blocks to the same radius as the wheels on the tread.

Mounting Large Photographs.—Methods of mounting photographic prints are explained on pp. 21 and 97, but the following refers to the mounting of large photographs measuring about 15in. by 20in. Having squared the print, turn it face downwards on a clean newspaper and pass a damp sponge over the back; at this the photo will usually rise and roll up, only, however, to stretch out quite flat a few minutes later on a second application of the sponge. The next thing is to cover the back evenly with strong starch paste, taking care that the edges are well coated. The end of the print nearest the operator is now raised by placing a table-knife under it, and is removed with the finger and thumb of both hands to a large sheet of cardboard, where it is again placed face downwards in such a position as to leave the required margin showing all round. A clean cardboard is now placed level with the far edge of that on which the picture is resting and allowed to drop gently into contact. Having rubbed well over the back of it with both hands, the top card may be raised, when the photograph will be found to adhere; and if the rubbing has been thorough no air blisters will be visible, the margin will be found correct, and nothing remains but to place the mounted picture between boards to keep it straight during the drying. The mounting of photographic panoramic views is different, as the sections must be pasted, placed in position, and rubbed down separately; take care to put the joins exact, and to press down thoroughly where they meet or overlap as the case may be. The best and, in fact, only sure method is to keep the section well up off the cardboard with the right hand until the left edge has been placed in position and made to intersect with the landscape; it may then be dropped and carefully rubbed down. This process is repeated until the picture is complete.

The Conversion of Thermometer Degrees.—In the Fahrenheit thermometer, the freezing point of water (actually the temperature of melting ice) is indicated by the number 32, and the boiling point by 212; in the Centigrade instrument, these respective temperatures are indicated by 0 and 100, and in the Réaumur instrument, by 0 and 80. The first-named thermometer owes its system of numeration to G. D. Fahrenheit, a German physicist living in Holland early in the eighteenth century, and elected a Fellow of the Royal Society of London in 1724; the Fahrenheit thermometer is used principally in Great Britain and Holland. The Centigrade thermometer, invented in 1742 by Anders Celsius, a Swede, is the standard instrument for scientific

Table for Conversion of Thermometer Degrees.

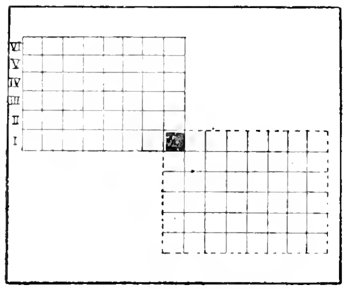
C.	F.	R.	C.	F.	R.	C.	F.	R.	C.	F.	R.
0	32	0	25·5	78	20·4	50·5	123	40·4	75·5	168	60·4
·5	33	·4	26	78·8	20·8	51	123·8	40·8	76	168·8	60·8
1	33·8	·8	26·1	79	20·88	51·1	124	40·88	76·1	169	60·88
1·1	34	·88	26·2	79·2	21	51·2	124·2	41	76·2	169·2	61
1·2	34·2	1	26·6	80	21·3	51·6	125	41·3	76·6	170	61·3
1·6	35	1·3	27	80·6	21·6	52	125·6	41·6	77	170·6	61·6
2	35·6	1·6	27·2	81	21·7	52·2	126	41·7	77·2	171	61·7
2·2	36	1·7	27·5	81·5	22	52·5	126·5	42	77·5	171·5	62
2·5	36·5	2	27·7	82	22·2	52·7	127	42·2	77·7	172	62·2
2·7	37	2·2	28	82·4	22·4	53	127·4	42·4	78	172·4	62·4
3	37·4	2·4	28·3	83	22·6	53·3	128	42·6	78·3	173	62·6
3·3	38	2·6	28·7	83·7	23	53·7	128·7	43	78·7	173·7	63
3·7	38·7	3	28·8	84	23·1	53·8	129	43·1	78·8	174	63·1
3·8	39	3·1	29	84·2	23·2	54	129·2	43·2	79	174·2	63·2
4	39·2	3·2	29·4	85	23·5	54·4	130	43·5	79·4	175	63·5
4·4	40	3·5	30	86	24	55	131	44	80	176	64
5	41	4	30·5	87	24·4	55·5	132	44·4	80·5	177	64·4
5·5	42	4·4	31	87·8	24·8	56	132·8	44·8	81	177·8	64·8
6	42·8	4·8	31·1	88	24·88	56·1	133	44·88	81·1	178	64·88
6·1	43	4·88	31·2	88·2	25	56·2	133·2	45	81·2	178·2	65
6·2	43·2	5	31·6	89	25·3	56·6	134	45·3	81·6	179	65·3
6·6	44	5·3	32	89·6	25·6	57	134·6	45·6	82	179·6	65·6
7	44·6	5·6	32·2	90	25·7	57·2	135	45·7	82·2	180	65·7
7·2	45	5·7	32·5	90·5	26	57·5	135·5	46	82·5	180·5	66
7·5	45·5	6	32·7	91	26·2	57·7	136	46·2	82·7	181	66·2
7·7	46	6·2	33	91·4	26·4	58	136·4	46·4	83	181·4	66·4
8	46·4	6·4	33·3	92	26·6	58·3	137	46·6	83·3	182	66·6
8·3	47	6·6	33·7	92·7	27	58·7	137·7	47	83·7	182·7	67
8·7	47·7	7	33·8	93	27·1	58·8	138	47·1	83·8	183	67·1
8·8	48	7·1	34	93·2	27·2	59	138·2	47·2	84	183·2	67·2
9	48·2	7·2	34·4	94	27·5	59·4	139	47·5	84·4	184	67·5
9·4	49	7·5	35	95	28	60	140	48	85	185	68
10	50	8	35·5	96	28·4	60·5	141	48·4	85·5	186	68·4
10·5	51	8·4	36	96·8	28·8	61	141·8	48·8	86	186·8	68·8
11	51·8	8·8	36·1	97	28·88	61·1	142	48·88	86·1	187	68·88
11·1	52	8·88	36·2	97·2	29	61·2	142·2	49	86·2	187·2	69
11·2	52·2	9	36·6	98	29·3	61·6	143	49·3	86·6	188	69·3
11·6	53	9·3	37	98·6	29·6	62	143·6	49·6	87	188·6	69·6
12	53·6	9·6	37·2	99	29·7	62·2	144	49·7	87·2	189	69·7
12·2	54	9·7	37·5	99·5	30	62·5	144·5	50	87·5	189·5	70
12·5	54·5	10	37·7	100	30·2	62·7	145	50·2	87·7	190	70·2
12·7	55	10·2	38	100·4	30·4	63	145·4	50·4	88	190·4	70·4
13	55·4	10·4	38·3	101	30·6	63·3	146	50·6	88·3	191	70·6
13·3	56	10·6	38·7	101·7	31	63·7	146·7	51	88·7	191·7	71
13·7	56·7	11	38·8	102	31·1	63·8	147	51·1	88·8	192	71·1
13·8	57	11·1	39	102·2	31·2	64	147·2	51·2	89	192·2	71·2
14	57·2	11·2	39·4	103	31·5	64·4	148	51·5	89·4	193	71·5
14·4	58	11·5	40	104	32	65	149	52	90	194	72
15	59	12	40·5	105	32·4	65·5	150	52·4	90·5	195	72·4
15·5	60	12·4	41	105·8	32·8	66	150·8	52·8	91	195·8	72·8
16	60·8	12·8	41·1	106	32·88	66·1	151	52·88	91·1	196	72·88
16·1	61	12·88	41·2	106·2	33	66·2	151·2	53	91·2	196·2	73
16·2	61·2	13	41·6	107	33·3	66·6	152	53·3	91·6	197	73·3
16·6	62	13·3	42	107·6	33·6	67	152·6	53·6	92	197·6	73·6
17	62·6	13·6	42·2	108	33·7	67·2	153	53·7	92·2	198	73·7
17·2	63	13·7	42·5	108·5	34	67·5	153·5	54	92·5	198·5	74
17·5	63·5	14	42·7	109	34·2	67·7	154	54·2	92·7	199	74·2
17·7	64	14·2	43	109·4	34·4	68	154·4	54·4	93	199·4	74·4
18	64·4	14·4	43·3	110	34·6	68·3	155	54·6	93·3	200	74·6
18·3	65	14·6	43·7	110·7	35	68·7	155·7	55	93·7	200·7	75
18·7	65·7	15	43·8	111	35·1	68·8	156	55·1	93·8	201	75·1
18·8	66	15·1	44	111·2	35·2	69	156·2	55·2	94	201·2	75·2
19	66·2	15·2	44·4	112	35·5	69·4	157	55·5	94·4	202	75·5
19·4	67	15·5	45	113	36	70	158	56	95	203	76
20	68	16	45·5	114	36·4	70·5	159	56·4	95·5	204	76·4
20·5	69	16·4	46	114·8	36·8	71	159·8	56·8	96	204·8	76·8
21	69·8	16·8	46·1	115	36·88	71·1	160	56·88	96·1	205	76·88
21·1	70	16·88	46·2	115·2	37	71·2	160·2	57	96·2	205·2	77
21·2	70·2	17	46·6	116	37·3	71·6	161	57·3	96·6	206	77·3
21·6	71	17·3	47	116·6	37·6	72	161·6	57·6	97	206·6	77·6
22	71·6	17·6	47·2	117	37·7	72·2	162	57·7	97·2	207	77·7
22·2	72	17·7	47·5	117·5	38	2·5	162·5	58	97·5	207·5	78
22·5	72·5	18	47·7	118	38·2	72·7	163	58·2	97·7	208	78·2
22·7	73	18·2	48	118·4	38·4	73	163·4	58·4	98	208·4	78·4
23	73·4	18·4	48·3	119	38·6	73·3	164	58·6	98·3	209	78·6
23·3	74	18·6	48·7	119·7	39	73·7	164·7	59	98·7	209·7	79
23·7	74·7	19	48·8	120	39·1	73·8	165	59·1	98·8	210	79·1
23·8	75	19·1	49	120·2	39·2	74	165·2	59·2	99	210·2	79·2
24	75·2	19·2	49·4	121	39·5	74·4	166	59·5	99·4	211	79·5
24·4	76	19·5	50	122	40	75	167	60	100	212	80
25	77	20									

investigations; whilst the Reaumur thermometer, which is the invention of a Frenchman of that name contemporary with Celsius, is used in Germany and Russia, but is being superseded. On the Continent the Centigrade instrument, which is in popular use there, is known as the Celsius thermometer. To convert F. degrees to C., subtract 32 and multiply by $\frac{5}{9}$; for example, 77° F. = $\frac{(77 - 32) \times 5}{9}$ = 25° C. To convert F. degrees to R., subtract 32 and multiply by $\frac{4}{9}$; for example, 77° F. = $\frac{(77 - 32) \times 4}{9}$ = 20 R. To convert C. degrees to F., multiply by $\frac{9}{5}$ and add 32; for example, 25 C. = $\left(\frac{25 \times 9}{5} + 32\right)$ = 77° F. To convert C. degrees to R., multiply by $\frac{4}{5}$; for example, 25° C. = $\frac{25 \times 4}{5}$ = 20 R. To convert R. degrees to F., multiply by $\frac{9}{4}$ and add 32; for example, 20 R. = $\left(\frac{20 \times 9}{4} + 32\right)$ = 77° F. To convert R. degrees to C., multiply by $\frac{5}{4}$; for example, 20 R. = $\frac{20 \times 5}{4}$ = 25° C. The tables on the previous page provide for the conversion of any degree between the freezing and boiling points of water in any one of the three systems above noted to either of the other systems.

Sand in Mortar.—In making mortar, sand is mixed with lime with a twofold purpose. Lime without sand sets or hardens so slowly as to be almost useless as mortar; but the addition of sand makes the mixture porous, and the carbonic acid in the atmosphere obtaining access to the lime sets up chemical action and causes the mixture of lime and sand to set or harden. The action of setting causes pure lime to contract largely in bulk; the admixture of sand with the lime prevents such contraction. Sand is added to Portland cement for economical reasons. This cement, used without sand, is exceedingly strong; for all ordinary purposes, this strength is unnecessary, and when the addition of sand does not unduly reduce the strength of the mixture, cement and sand may be economically used together.

Preserving Cut Flowers.—Perhaps the easiest way of lengthening by many months the life of cut flowers is to dip them immediately after gathering into weak gum water, and after allowing them to drain for a few minutes to arrange them in a vase. The gum forms a protective coat on the flowers, and preserves their shape and colour for months after they have become dry. To preserve flowers for merely two weeks or so, keep their stalks in a weak solution of saltpetre or carbonate of soda in water. By standing a vase of cut flowers in the centre of a flat dish in which is a little water, and inverting a bell glass over the vase, the flowers will be surrounded with a moist atmosphere, and their life will be prolonged. Or, instead, when treating small and short-stemmed flowers, insert them in damp silver sand and invert a tumbler or a bell glass over them. The forms and colours of flowers can be preserved for a long time by treating them as follows: Provide a cylinder having a removable cover and bottom; stretch a piece of metallic gauze over the top, replace the cover, and invert the vessel. Sift a quantity of sand, sufficient to fill the vessel, and gently heat over the fire in an iron pot, well stirring in ½ oz. of stearin for every 100 oz. of sand; a greater proportion of stearin sinks to the bottom and injures the flowers. Place the latter on the gauze in the inverted vessel and pour in the mixture of sand and stearin so gently that the leaves and flower petals are not caused to touch one another. Replace the bottom of the vessel and keep in a hot place for eighteen hours; then remove the cover and the sand will run away through the gauze, leaving uninjured the flowers, which will be found to have retained their natural colours. Another method is to embed the flowers in a mixture of equal parts of plaster-of-Paris and lime, and gradually to heat them to a temperature of 100° F. (38° C.). On removal from the mixture the flowers look dusty, but if left for an hour, so as to absorb atmospheric moisture, the dust can be removed without injuring the flowers. Often a hoary appearance is left, even after dusting, and this is removed by coating once or twice with a varnish made by dissolving 5 oz. of dammar in 16 oz. of oil of turpentine, adding 16 oz. of benzoline and straining through muslin. Another suitable varnish is made by dissolving 1 part of transparent copal in 25 parts of ether, mixing in 1 part of sand and straining through muslin. When using this latter varnish, immerse the flowers for two minutes, dry for ten minutes, and repeat these operations five or six times. Also, the hoary appearance may be removed by immersion in a solution of 30 gr. of salicylic acid in 1 qt. of water. A method resembling one previously described is the following: Thoroughly dry and sift 1,000 parts of fine white sand and well mix with a solution of 3 parts of stearin, 3 parts of paraffin, and 3 parts of salicylic acid in 100 parts of alcohol. Spread out the sand, allow it to dry, and with it cover the bottom of a box and lay the cut flowers on this bed of sand. Dust on the sand very gently until the flowers are covered, close the box, and maintain it at a temperature of from 86° to 104° F. (30° to 40° C.) for two or three days. Withered flowers should be freshened before being treated as above by being dipped into alcoholic solutions of suitable aniline colours.

Postage Stamp Photographs.—In a postage stamp camera a battery of small lenses is always employed, both for the sake of speed and for economy, and for these lenses a square bellows is essential. Postage stamp photographs may, however, be produced as follows. Make (to serve as a copy) a negative, postage stamp size, on a ¼-plate or on a smaller plate, and fix this negative in the centre of a glass in a 12-in. by 10-in. frame, placing between it and the glass a sheet of white, smooth card in which a hole the exact size of the small negative has been cut. This card serves as a mask for the dry plate on which the negative is to be multiplied. A trial should be made on a small plate in order to ascertain the exposure necessary to give the correct contrast and gradation in the finished negative—for it must be borne in mind that the plate exposed behind the



Postage Stamp Photographs.

negative will give a positive from which the final negative (that is, the negative from which the prints are to be obtained) must be made in a second exposure. The white card is then ruled into spaces as shown in the diagram, and the negative is placed for the first exposure as indicated by the dotted lines. Now move the negative forward one square after each exposure till the end of the row is reached, when the operation is repeated along the remaining rows of squares. Of course, the exposures must all be made to the same light and at exactly the same distance from the light. This method of multiplying a negative is far simpler than at first sight appears, for, when properly understood, the whole series of exposures may be made in a surprisingly short time. From the positive so obtained several negatives may be made from which thousands of photographs may be printed in a day.

Testing Crimson Lake.—A pure crimson lake contains the colouring matter of the cochineal, known as carmine, precipitated on a base of alumina, but scarlet lakes contain vermilion. A pure crimson lake should dissolve entirely in a solution of caustic soda, yielding a bluish-carmine solution, and it will precipitate out again by carefully neutralising with dilute acid. As a rule, pure crimson lake does not yield colour to alcohol, whereas the aniline so-called lake colours usually tint alcohol very strongly because the colours are but weakly held by the base. The colour of cochineal lake becomes bluer with ammonia and yellower with an acid, but the behaviour of lakes containing aniline colours will vary with the nature of the colour used. Crimson lake, when carefully heated in a porcelain dish, should burn away, leaving a small quantity of a light white ash; a large amount of residue, either white or coloured, shows evidence of adulteration with mineral matter. Crimson lake, being a bad drying pigment, should be ground with boiled oil, if oil is used; but it would be better to apply the lake ground in turps and to varnish over it, or to grind it in a quick-drying varnish. In any case it is a fugitive colour, fading in bright sunlight very rapidly.

Cleaning Silk Tapestry Covers. Some furniture silks are heavily charged with filling or dressing, leaving very little body or strength to the fabric. It is next to impossible to make such silks look presentable after being subjected to one of the wet cleaning processes which very often discharge the colours. All grease spots must first be removed. To do this, make up a solution consisting of ¾ pt. of water, ¼ pt. of benzine, 4 oz. of ammonia, and 1 oz. of a strong solution of sal-soda; mix in a bottle and well shake, then let it stand for a few hours. Make a soft rag pad or rubber, and slightly damp (not wet) it with the liquid, and with this rub the spots gently until they disappear. Allow the surface to get thoroughly dry, then sprinkle with dry oatmeal, which must be well rubbed in with a furniture brush. As the oatmeal gets dirty, supply fresh, and finally brush it all out. In place of oatmeal, dry fuller's-earth can be used.

Making Insect Cases.—The construction of a case to hold butterflies, moths, etc., is very simple. Make an ordinary box of the size required, and across the middle put a partition dividing the box into two; hinge the lids as shown in Fig. 1, and fasten them with hasps, locks, or straps. Fig. 2 shows the construction of another form of case. Assuming that the insects are to be "set" in the field and pinned inside the box, the whole of the inside of the box may be covered with entomological cork, procured in sheets about ⅛ in. thick; though this would be very bad policy, as the box will hold comparatively few. Collectors always place the captives in envelopes and "set" them at home. The usual method is as follows. On catching the insect, pinch it under the wings between the finger and thumb, when it will at once be killed, and its wings will be close together, thus preventing the "view side" from being rubbed. Now take a small square of paper, and crease it as shown by the dotted lines in Fig. 3. By folding 1 over 2 and 3 over 1 a triangular envelope is formed, into which the insect is dropped; fold 4 over 3, and the insect will be in the position shown by Fig. 4. Of course, the cork is not necessary in this case.

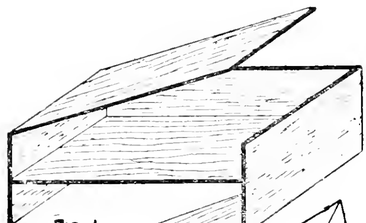


FIG. 1

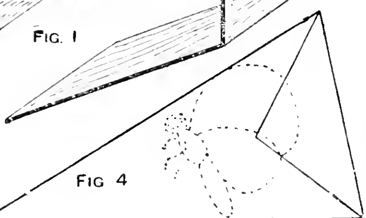


FIG 4

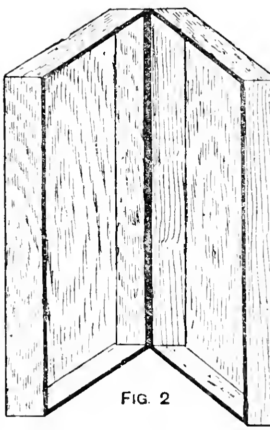


FIG. 2

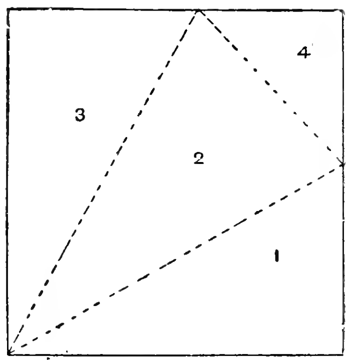


FIG 3

Insect Cases.

Turning and Polishing Ebonite and Vulcanite.—To turn ebonite and vulcanite, use tools of good steel, but sharpened at about the same angles as for hardwood, ivory, and brass. Rough out with a round-nose tool, and finish with a flat-faced brass-finishing tool or scraper. Run the lathe at a moderate speed, and take light cuts. To save time and material, the ebonite and vulcanite slabs may be cut into square pieces with a fine circular saw provided with a shifting fence or guide. Next get several pieces of steel tubing of a length and diameter that will most nearly fit the shape of the required work. Soften the tubes by placing in a moderate fire, and leave them there till the fire dies out. Then, with a saw-file, notch one end of the tube like a saw, and harden and temper to a straw colour. Now prepare a wood chuck, to hold this cylindrical saw, by boring a hole in the face right through the block and slightly smaller than the tube, so that it may be driven home truly. This is of importance, as if the arrangement does not run dead true it will not act. Cylindrical saws on this principle may be used with success when hollow cylinders are to be cut out of the solid, as for ivory, though, in the latter case, the saws would be better held in a self-centring chuck. To use these saws, drive the lathe at full speed, apply the material to be rounded to the saw, and feed with the back-centre. Boring may be done in a similar manner. To get a polish on ebonite or vulcanite, several grades of emery cloth may be used while the work is revolving in the lathe, finishing with putty powder sprinkled on an oily piece of blanket or thick cloth, and, finally, with dry putty powder (oxide of tin) or whiting on a soft leather. A single piece of ebonite or vulcanite may also be partly turned, filed to shape, and scraped and polished by hand, using the materials above mentioned, but in the finishing of large quantities time is saved and the work is done more effectually if polishing dollies are used.

Improving Thin Photographic Negative.—When it is desired to improve a very thin photographic negative so as to yield a fairly good picture, first ascertain whether the negative is thoroughly free from hypo. This is essential, no matter what process of intensification is employed. The negative may be tested for hypo by mixing with a weak solution of iodide of starch some of the final drippings from the negative when it is removed from the washing water. If hypo is present in the film the colour of the starch will be discharged. Or, as a precautionary measure, the negative may be placed for a time in a 2-per-cent. solution of anthion, which readily removes hypo from the film, and then well rinsed in water. To intensify a negative, a portion of the image consisting of metallic silver must first be converted into silver chloride, and to bring about this result the negative is placed in a solution (a saturated solution of mercuric chloride) from which chlorine can be absorbed. In this solution the negative remains until it is bleached white. The degree of bleaching governs the degree of intensification, but must not be overdone. Next wash the negative well for ten minutes to free it from any excess of mercuric chloride. The negative is then placed until it becomes black in a 10-per-cent. solution of sulphite of soda. During the immersion the dishes containing both solutions should be rocked, to avoid uneven markings. The density, particularly of the lights, will be found to be considerably increased after the blackening of the negative. There are other methods of intensification, and the most popular of them (probably because a long range of effects is obtainable with it) is to blacken with ammonia, but the mercury and soda process described above is the one more likely to be successful in the hands of a beginner, as there is with this process a greater freedom from stains than with mercury and ammonia. Intensification is not necessarily permanent, therefore negatives that have been so treated require careful preservation. The process may, of course, be carried out in full daylight. Contrasts may also be forced up by printing from the negative on bromide paper.

Making Peroxide of Hydrogen.—Peroxide of hydrogen is made by suspending barium peroxide in water and adding the requisite quantity of dilute sulphuric acid. Barium sulphate is precipitated and hydrogen peroxide remains in solution and is concentrated at ordinary temperature in a partial vacuum over sulphuric acid. Seventeen parts of barium peroxide will require 10 parts of strong sulphuric acid, previously diluted with 10 parts of water, for its decomposition.

Re-inking Typewriter Ribbons.—Few quite satisfactory methods of re-inking typewriter ribbons are known. By a simple method, the ribbon is stretched and drawn over a bottle, the ink being brushed on as the ribbon passes. Use only a little ink and apply it to but one side of the ribbon. Another method would be to pass the ribbon between two pads, one or both of which could be inked. Or it many ribbons were to be dealt with, a frame carrying two felt-covered rollers could be constructed. One roller could be turned by a crank, the necessary motion being conveyed to the other roller by friction. An arrangement could easily be made by means of which the rollers could be supplied with ink, and the ribbons could then be inked easily by merely passing them between the rollers.

Jewelling the Pallets of a Regulator Clock.—In jewelling a pair of dead-beat regulator pallets, the pallets must first be softened, then wide and deep slots must be filed out where the teeth engage with them. Jewels (rubies, garnets, or agates) are then cut and polished to fit exactly the grooves and are cemented in with shellac. Their outside surfaces are then polished off flush with the steel on all faces. For rubies and garnets, the cutting and polishing is done on steel or iron laps with diamond dust. Agates, being softer, can be cut by emery used in the same way.

Bath and Dipper for Ferrotype Photography.—An upright bath (Fig. 1) is the more convenient form for use in the ferrotype process of photography. This bath is not very easy to make, and can be purchased very cheaply. A flat porcelain dish may be used as a bath, but must be kept well covered as it offers a large surface for the deposition of dust. For a dipper (Fig. 2), cut a piece of glass A and attach with good cement a strip at B. The plate then rests on B face up and may be lowered gently into the bath.

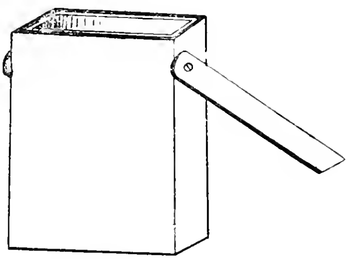


FIG 1

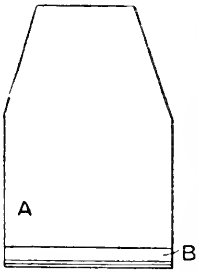


FIG 2

Bath and Dipper for Ferrotype Photography.

Making a Theatrical Bald Wig.—The foundation of a theatrical bald wig is made of stout brown calico, which is cut, sewn, and fitted to a barber's block, as is explained on p. 19. Prime the calico with size to which a little whiting has been added; allow this to dry, then remove the calico from the block. For the hair, stitch in white Berlin wool; or a piece of fur could be used. When this is done, place the calico again on the block, and paint the bald part with a mixture made as follows. Mix a little white lead with a touch of vermilion and Indian yellow to form a flesh tint, then add a few drops of linseed oil, turps, and a little gold size. Allow it to dry, and then apply a second coat.

Producing Photographs in Relief. — To produce photographs in relief, soak some fairly stout sheet gelatine for half an hour in a 5-per-cent. solution of potassium bichromate. This renders the gelatine sensitive to light on drying, which must take place slowly in a well-ventilated and dark room. It is advisable to squeeze the gelatine down on to plate glass (as in enamelling a print); the glass gives the gelatine a good smooth surface for rendering minute detail. When dry the gelatine is stripped from its glass support and exposed beneath a negative. The bichromated gelatine when exposed to light becomes insoluble and incapable of absorbing moisture in proportion to the intensity of the light's action on it. If the gelatine be now placed in cold water those portions of gelatine unaffected by light will begin to swell. As this expansion or swelling will be in width as well as thickness, the gelatine should be fixed with isinglass to an insoluble support; this compels the gelatine to swell upwards. If a cast is taken of this picture in relief the modelling will be negative and reversed. Therefore, proceed as follows. A positive showing a good degree of contrast and gradation, such as would be suitable for carbon printing, must be first taken. This positive should be thin and full of detail, with the lights and shades due as far as possible to form. To remedy the false relief due to colour, intensify with uranium and remove the effect locally as desired with a weak solution of ammonium hydrate. After printing, thoroughly soak the gelatine in a dish, then carefully remove and blot off all moisture, oil the gelatine mould and drain off the excess, and place the mould in a sort of tray made by bending up the edges of a piece of stiff paper. Mix up some fine plaster-of-Paris and pour it over the mould. Another method that may be used where only general effect is required is described below. A pad consisting of a board covered with velvet or plushette will be required, together with some modelling tools and a board covered with carbon paper. A print is mounted with seccotine or other cement on a thin sheet of soft lead; on the other side is pasted a sheet of white paper. Lay the mounted print, face up, on the carbon paper and trace on the print all the parts of the picture that should stand in relief. Lay the print face down on the plush block, and, using the traced lines on the back of the print as guides, press out those parts that are to be in relief. Now turning the print over (that is, letting it lie face upwards) press back the shadows, putting in any sharp edges with the pointed end of the tool. As the print is fastened to the metal the shape of the print will remain unaltered, and it may be mounted on a card with gelatine. Platinotypes give the most satisfactory results with this process, both on account of their colour and their malleability. The process is so simple that artistic ability and practice are all that are needed in order to obtain the best results.

Recipe for Harness Composition.—A recipe for a waterproof harness composition is: In a glazed vessel melt 2 oz. of black resin over a fire and add 3 oz. of beeswax. When thoroughly amalgamated, remove from the fire, and add ½ oz. of fine lampblack and ½ dr. of Prussian blue in powder. Stir well together, and add sufficient turpentine to form a thin paste. When cool, apply with a sponge and polish with a soft brush.

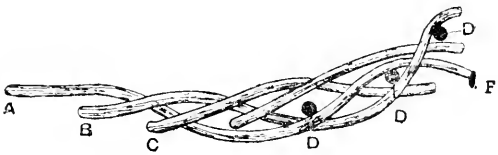
Moulds for Casting Brass.—For very delicate work, loam, which is a clayey sand mixed with ordinary sand, must be used. The mould can be made in the ordinary way, but it must be well dried on both sides if double-faced work is to be done; for single-faced work only one side will need well drying. When the mould is thoroughly dry, its faces must be smoked by means of a torch made from pitch. This deposits over each part a surface of finely divided soot. The pattern must then be inserted and the two halves of the mould brought together and screwed up, which will bring out the impression of the pattern sharp and clear. If loam is used for making the moulds, it should be mixed with facing sand. For small castings, charcoal powder mixed with about one-eighth of its volume of fine sand may be used, or the mould may be dusted with pea-flour and finally with charcoal. In moulding the thin parts of a delicate pattern, the mould must not be rammed too hard, as the metal, on cooling, will contract; if the mould will not give way, the metal must do so, and consequently there will be flaws or cracks in the casting. This may be prevented by slightly damping the thin part of the mould with charcoal and water.

Magnetic North.—An ordinary pocket compass, or any instrument containing a magnetic needle, will give the direction of the magnetic north at the time and place where the compass is used. The direction of the magnetic north with regard to any given line of the survey can be ascertained by standing on the line and looking across the face of the compass, but it must be remembered that the direction of the magnetic north or, in other words, the magnetic meridian, is not constant. It is the direction of the mean resultant of the magnetic forces in the earth, and the virtual centre of the forces travels round the geographical north pole, so that in the neighbourhood of London the needle has a range of 30° east and west of the true north. The position of the needle was at the beginning of 1900 something less than 16½° west of the true north, and this distance is being reduced at the rate of about 7 per annum.

Working Electro-gilding Solutions.—A very dark brown deposit of gold from an electro-gilding bath is generally caused by excess of current, but may also be due to excessive free cyanide and to a deficiency of gold in the solution. The current may be reduced either by employing a resistance coil or by reducing the battery power. Excessive free cyanide may be reduced by dissolving more gold in the bath, or by adding cyanide of gold until the excess cyanide of potassium has been taken up.

Making Pleated Back Squab for Carriage.—Below are instructions on making a pleated back squab or cushion for a carriage. To get the size of the squab, the part that has to be filled should be loosely fitted with canvas; carefully mark round it to get the exact shape and size. This canvas is then laid on the bench, and the positions of the tufts and pleats are set out. To get the fulness for the pleating and stuffing, make elevations of the finished squab. From this drawing measure with the tape the amount of fulness required, and cut the material accordingly. If cloth is used, the pleats, after being marked out from the canvas, are ironed to give them form; if morocco is employed, the pleats are folded with the faces together and hammered on the lap or flat iron. When all the pleats are formed, the holes for the tufts are punched through the two thicknesses. Various methods are employed in making up the squabs. They are sometimes made on a frame; at others they are made on stout canvas and fixed to the bench; and sometimes the front is tacked to the back, and partly stuffed before the tufts are put in. Whichever method is adopted, be careful to keep a uniform fulness between the pleats and to get them to line flat and true.

Making Hand-guards for Singlesticks.—In making baskets or hand-guards for a pair of singlesticks, take about eight long thin osiers and with them form a slarth. As both butts and tops of these eight osiers are to form the border, they must be laid thus—a butt, a top, a butt, and so on. Use two small rods to tie the slarth. Four of the eight osiers will have to be laid first, then the other four across them. When the tie-rods have been worked alternately twice round, the osiers are opened in turn by working the tie-rods between them, thus forming sixteen uprights to receive the weaving, or pairing. A small piece is scallomed at the butt of one tie-rod and lapped round the four under rods. To get the hand-guard to shape, carefully gather the sixteen stakes and place them in a small hoop; peg the whole to the edge of the workboard with a small bodkin or wire nail passed through a leaden weight. Now form each stake by gently pulling and bending. Take two small rods, place one top behind a stake, with the tip end in front of the stake before it, and the other rod behind the next stake to the right; then pair these two rods round one over the other in and out of the stakes. When they will not work further, piece them with the butt ends of two other rods. Pair the work to the proper depth, which will be between 3in. and 4in., when the stakes can be laid down to form the border, as in the above sketch. A, B, and C are first laid down, each stake passing behind two others, in front of the third and fourth, and finishing in front of the sixth, as shown at F. The stakes D are to be laid down in turn. The fencing-stick, a stout ash stick, is passed through near the border of one side of the guard, and out near the crown at the opposite side. Small wood pegs are put in the sticks outside the baskets to keep them from sliding off the ends.

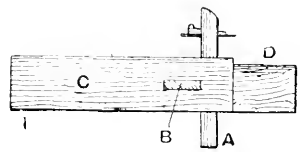


Making Hand-guards for Singlesticks.

Painting a Farm Waggon.—Here are instructions on painting a farm waggon. The body is to be blue lined out with red and white, the undercarriage is to be blood red picked out with black, and the lettering is to be in golden yellow. To prepare the body for the two coats of blue, three coats of dark lead colour should be given, any screw- or nail-holes being stopped up between the second and third coats. The blue generally used on this kind of work can be obtained at most colour warehouses ready ground, and for use requires thinning down only. The first coat of blue should be made to dry in about eight hours; the second coat should have a good proportion of varnish added to give a better surface to line out upon. This second coat will require flatting. This will make the varnish adhere properly, and will remove any nibs on the surface. For lining out, use vermilion mixed stiff with carriage varnish and thinned down with turpentine from the dipper when in use. These lines must be allowed to dry before putting on the white lines, for which tub white lead mixed with pale varnish may be used. To prepare the underworks, give two coats of colour made of tub white lead, driers, linseed oil, and turpentine, with sufficient red lead added to give tone. Blood-red paint may be obtained ready ground, and is known as ruddle; should a brighter red be required, give two coats of Chinese red mixed with gold size, turpentine, and varnish. For picking out the carriage, use drop black ground up with varnish. For the lettering, deep orange chrome toned down with white as desired should be used. For a lasting job the cart should be given a coat of undercoating varnish, followed by a coat of finishing carriage varnish, care being taken to flat down between successive coats and to wash off thoroughly, so as to remove any particles of dirt, as should any get into the varnishing brush the whole job will be spoiled.

Sun-printing on Embossed Glass.—The method employed in sun-printing for repeating designs on glass embossed work is as described below. To make the sensitive resist, crush to a fine powder 1 cub. in. of pure asphaltum and dissolve it in 8 oz. of benzine. This operation must be carried out in a dark room, or a room dimly lighted by gas, and great care must be taken that the light does not strike the mixture, which must be kept in a black bottle. To use the resist, coat the glass to be etched in the dark room. Place the negative, which must be black and white, in a photographic picture frame, and expose; one hour will be sufficient in a strong sun, but in dull weather a whole day will be necessary. Then wash over with paraffin; the part acted upon by the sun will adhere to the glass and form the resist. Now etch in the usual way.

Gauge for Inlaying Purfling on Violin.—The accompanying sketch shows a useful form of purfling gauge, easily made and very effective. A is a sliding bar carrying the cutter and wedge, B is the wedge for fixing the sliding bar, and C is a hardwood stock with the bottom rounded on one side as at D. The method of using is to set the cutter, which must be well sharpened, to the required distance, and to go round the violin, being very careful not to cut too deep; then reduce the width by $\frac{1}{16}$ in. and cut the outer line. The wood between the lines can then be picked out with a bent purfling chisel, and the purfling fitted and glued. The mitres at the corners must be perfectly true; an examination of a good violin will show how this should be done.



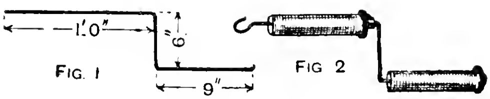
Gauge for Inlaying Purfling on Violin.

Repairing and Painting Wire Gauze Blinds.—To repair an ordinary wire gauze blind, fix the frame on a clean, flat bench; lay the gauze on, and secure it along the bottom with $\frac{1}{4}$-in. blue tacks. The tension is obtained by compressing the stiles slightly together and tacking towards the angle of the rebate, beginning at the middle of each stile and top rail and finishing at the corners. Bell staples are sometimes used to obtain more tension, but straining too tightly makes the stiles crooked. For a brass tubular top rail, the gauze must first be cut to the outline, and a stout wire sewn with wire to the folded shaped edge. The prepared wire is then put in the top rail through the end, the gauze being passed through the cut in the tube; then spring in the tubular top rail, and proceed as described above. To paint, lay the gauze on a flat, clean table, and with a large stencil or other square-ended brush pounce the colour on sparingly, not with up and down strokes, which fill the meshes. The colour, which must be thin, is mixed with turps, driers, and boiled oil; two coats are required. To dry, suspend the blind.

Black Bronze for Iron.—The article to be blacked must first be well cleansed from grease, and then dipped into a solution consisting of 1 part of bismuth chloride, 2 parts of mercury bichloride, 1 part of copper chloride, 6 parts of hydrochloric acid, 5 parts of alcohol, and 50 parts of water. When dry, place the article in boiling water for half an hour. If the black is not intense enough, repeat the dipping operation. The colour is fixed by placing the article for a few moments in a bath of boiling oil, the article being afterwards heated until all the oil is driven off. This treatment is said to give an intense black finish.

Making Pincushions from Cow's Hoofs.—In making pincushions from a pair of cow's hoofs, scrape out the insides of the hoofs with a knife, and well wash with carbolic acid or sprinkle with alum. Then polish the outsides. To do this, first file off all roughness, afterwards using glasspaper, commencing with coarse and finishing with the finest. Then rub briskly with an oiled rag and putty powder, followed by whiting moistened with vinegar. Now well rub with some crumpled-up tissue paper, then with the palm of the hand with or without oil. The rubbing must be briskly done, and the work well dusted between every two operations. Now partly fill the insides of the hoofs with a mixture of plaster-of-Paris and water and allow to dry. Fill the remaining space with bran or sawdust and cover with velvet, fastening the edges with glue or a few fine gimp pins. Just before putting in the last tack or gimp pin, ram more bran in so that the inside will be quite firm and the top nicely rounded. Then cover the junction of the velvet and horn with gold lace, and the pincushion is complete.

Making Straw Bands or Ropes.—Where short lengths only are required, say up to 20 ft., the straw bands or ropes are best twisted by hand. To do this, a simple twisting hook, as shown below, is needed. It consists of a piece of stout iron wire bent to form a handle, as in Fig. 1. Two pieces of ash, oak, or chestnut, 8 in. long, are cut from a dry faggot and bored to take the wire. One of these pieces is pushed on the shorter end of the wire, which is burred over a washer, keeping the wooden handle in place. On the longer end put an old iron nut, a washer, and the other piece of wood; then bend the end to form a hook, as shown in Fig. 2. A hook clamped in the jaws of a carpenter's brace would answer the same purpose. To make a band, the straw must be well wetted and lightly tossed up in a heap; the operator, standing with the heap on his right, puts the bight of a wisp over the hook, which is to be turned by a boy. Some skill is essential in feeding the twisting band, which passes through the left hand while the right keeps adding fresh wisps. When twice the length required has thus been twisted, the centre is thrown over a stake previously driven in the ground; the boy, keeping a strain on it, gives his end to the man and takes up the centre bight off the stake, and with his hook twists in the opposite direction. When long lengths are required, a "jenny" is necessary; this is an arrangement of cogwheels by which two, three, or four strands can be twisted separately and together as the outer wheels are thrown in or out of gear. The machines can be bought at ships' stores; they are used for making marline, spun yarn, and nettle stuff at sea.



Twisting Hook for Making Straw Bands.

Rusting of Galvanised Iron Tank.—The rusting of a galvanised iron tank often is due either to soft water having been used or to the water being softened by heat; the latter would be the case when the tank is above a gas engine exhaust or in a hot position. Galvanised iron cannot resist the action of soft water, and quickly perishes if exposed to such action. A coat of lime-white may delay the rusting, provided it has not got a firm hold. The existence of lime in hard water prevents its having the active effect of soft water on iron, lead, and zinc.

Building Stones.—York stone is the best known of the sandstones. It is composed of grains of silica or sand cemented together with silica, carbonates of lime and magnesia, alumina, and oxide of iron. York stone is obtained chiefly from the Coal Measures and from the Millstone Grit series, though some of it is got from the New Red Sandstone formation. York stone is obtained from a large number of quarries in Yorkshire and in the surrounding counties. The most noted quarry is the Bramley Fall, which, however, was worked out long ago; but a good deal of stone of a similar character is found to the north of Leeds, and is sold under the name of Bramley Fall. Other well-known quarries are Robin Hood, Park Spring, Potter Newton, and Howley Park. York stone is of a light yellowish or ferruginous brown colour, though some varieties show a bluish tinge. Bath stone is an oolitic limestone, consisting of grains of carbonate of lime cemented together with the same substance or by some mixture of lime with silica or alumina. Bath stone is very soft when first quarried, but hardens on exposure to the air. It is necessary that this stone should, in a building, be placed on or parallel to its natural bed. The best known Bath stone quarries are Box Ground, Combe Down, Westwood Down, Corsham Down, Corsham Ridge, and Stoke Ground. Stone from different quarries, and from different beds in the same quarry, varies much in quality; some kinds of Bath stone weather very badly, and can only be used for internal work, whilst other kinds are fit for external work in ordinary atmospheres. Craigleith stone is a sandstone composed of quartz grains interspersed with small grains of mica, and united by a siliceous cement. Craigleith stone contains 98 per cent. of silica, and only about 1 per cent of carbonate of lime. The stone is found near Edinburgh; it is used extensively in that city, and is also exported. It is perhaps the most durable sandstone in the United Kingdom. As regards durability when employed for facing the elevation of a building the stones may be placed in the following order. (1) Craigleith; (2) York stone; (3) Bath stone. The atmosphere of all large towns contains a sensible proportion of acids (such as sulphuric acid, nitric acid, etc.) derived chiefly from smoke and from the exhalations of chemical works. These acids act destructively upon carbonate of lime, and the stone containing the largest proportion of lime, or in which the lime is more readily acted upon, disintegrates the most rapidly. Hence a sandstone is to be preferred for use in an acid-laden atmosphere. Craigleith, being the less porous of the two sandstones, resists the action of frost better than York stone.

Repairing Oval and Square Baskets.—Baskets should be repaired before they are too badly worn. As soon as the foot rim gets broken, well soak that part, draw out all foot stakes (with pincers, if necessary), and put on a new rim. If there is no foot rim, cut out the worn bottom with shears; or, if the bottom part is thoroughly soaked, the workman can push it inwards with his foot. If the bottom edge of the body itself is worn, pull off a few rounds, push down a stake wherever one may have worn or broken, and work some upsetting to replace that which has been removed. A new bottom must now be made to replace the old one. Of course, the stakes in the body must be cut quite level all round at the bend after the upsetting has been finished off. Occasionally gauge the bottom to the body so as to get a good fit; then cut off the ends of the bottom sticks, and tie in the bottom with osier bands. An oval basket will require about six bands, two at each side and one at each end. A large square basket may require eight or ten bands, three at each side and two at the ends. To keep the bottom in place while tying, push two or three bodkins through the upsetting and into the bottom, down beside the bottom sticks. Next pick out and point six or eight band rods. Push one down the upsetting in the body, and commence twisting it rope fashion from the tip end to the butt. The rod can now be drawn in and out exactly as can a piece of rope. With the bodkin, open the weaving in the bottom, about 4 in. from the edge, at the right-hand side of the nearest bottom stick; pull the band through from the inside, then out again at the other side of the same stick; twist it over the 1-in. lap twice, pulling it very tight and even, then carry it for about 6 in. up the side of the basket, and push it through to the left of a stake. Bring it out to the right about 1 in. nearer the bottom, and again twist it over itself three times along the bottom twisted part; return it through the first loop, still keeping an even twist, then pass it through the edge of the bottom, and upset, again forming a close and even twist up the side; finally, pass it through the side loop, pull very tightly, and cut off the waste piece neat and close. The accompanying illustration shows part of a tying-in band. A is passed through the side of the body and comes out again at the right-hand side of the stake, and is worked the whole length again, when it is turned in the loop in the bottom (outside), and finishes as at C, outside. The even twist is obtained by pulling tightly. When all the bands are finished, a foot rim can be worked on. Should any of the top border stakes be broken, push down others in their places, bend them down, draw them through from the front, and cram them. Some stakes will simply require pushing through the border from the front and cramming, the inside end being cut off close.

Repairing Oval and Square Baskets.

Lettering Shop Blinds.—Shellac dissolved in a saturated solution of borax as a vehicle, chiefly for black, is sometimes used for lettering union blinds. So also are artists' tube-oil colours mixed with varnish or gold size. As a slight creeping of oil is unavoidable, the colour must be quick-drying. The lettering can be done with size only as a preliminary, but no general treatment of the ground is possible.

A Model Fumping Windmill.—The little windmill here described is easily made, and works well in quite a moderate wind. It may be made in any size, even with the wheel ½ in. in diameter, but the one illustrated has a 1-in. wheel, and the drawings are quarter full size. For larger or smaller mills, all the parts may be kept in about the same proportion. The wheel A (Fig. 1) and rudder B are best made of thin sheet brass, but tin-plate is found quite suitable if it is painted. For the wheel, strike a circle 4 in. in diameter, and a smaller one ¾ in. in diameter, and concentric. Then divide the disc into eight sections (see Fig. 2), either by using set-squares, or by dividing the circle into two parts and stepping the compasses four times round each semicircle; a $\frac{1}{8}$-in. hole is bored in the centre of the circle, and it is then carefully cut out with a pair of shears. Afterwards the eight radiating lines are cut down, as shown, to the inner circle; all sharp corners are then snipped off and trimmed with a file. The rudder B (Fig. 1) is about 3 in. long and 2½ in. and 2 in. wide at the large and small ends respectively, and it should be trued up at the edges with a file. The pump barrel C is a brass tube about ½ in. in diameter and 3 in. long. With a file the ends are trimmed square to the length. A small hole is bored through the tube at D about

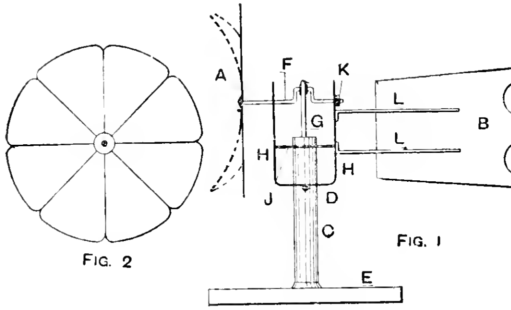


FIG. 2 FIG. 1

A Model Pumping Windmill.

1 in. from one end, and a little plug of iron or brass wire is soldered or forced in, leaving ¼ in. protruding at each side, the ends being rounded. The stand E is either a heavy sheet-iron plate 4 in. by 4 in. by ¼ in., or a light metal one screwed to a wood base; on it, at the centre, the pump is soldered upright. The crank-shaft F is made from steel or iron wire about $\frac{3}{32}$ in. in diameter and 3½ in. long. The crank is made by heating the metal red hot and bending it with a pair of pliers or in a small vice; the throw of the crank should not be more than ¼ in. The pump rod G is made of thin brass or iron wire about 2 in. long, and one end is bent over into a circle to fit loosely on the crank-shaft. The frame is of brass 5½ in. by ¾ in. by $\frac{1}{16}$ in., and is bent as shown at H. To bend brass or copper, it is annealed by heating it to red heat and cooling it suddenly in cold water, after which it bends easily and without breaking. A hole is bored in the bottom to fit the tube C; also one at each side at the top to take the crank-shaft. A second piece of brass J is cut about 1¼ in. by ¾ in. by $\frac{1}{16}$ in., and a central hole is bored in this to fit the pump barrel. The piece is now soldered about ¼ in. up the frame. The wheel A is soldered true to the shaft, and about ¾ in. out from the front bearing, the space being filled with a washer made by coiling some No. 18 S.W.G. copper wire round the shaft, the ends being filed so as not to catch anywhere. The wheel and shaft are now put into the bearings, the latter being sprung if necessary. The protruding ends are sawn or filed off, and a washer K, made of No. 16 S.W.G. copper, is soldered on. The pump rod G is put in place, and two small copper wire washers are soldered on the crank-pin to prevent the rod having too much side play. The lower end of the pump rod must be cut shorter if it does not allow the crank-shaft to rotate freely. The rudder is soldered to two brass wires L about 3 in. long, and these are soldered to the frame. Finally, each blade or section of the wheel is given a twist as in a screw propeller or fan, and as indicated for two sections. When the mill is running, the vane or rudder should keep it well into the wind. All iron or tin parts should be painted, and the bearings oiled. The holes can be bored with common bradawls sharpened like an ordinary metal drill, and the larger holes may be finished with a round file. All parts to be soldered should be very clean, zinc chloride being used as the flux.

Polishing Heads of Brass Screws.—Brass wood-screws are usually polished in a shaking barrel about 18 in. in diameter by 2 ft. 6 in. long; the barrel is actuated by steam, or, if machine power is not available, by hand. The barrel is two-thirds filled with clean beech sawdust and the screws are put in. The friction caused by the screws coming in contact with each other and with the dust gives the polish.

Tempering Steel.—Molten lead is a good heating agent for tempering steel articles of unequal thickness, as these can be heated more uniformly by this method than by placing in an open fire or by supporting on an iron plate over a fire. Lead melts uniformly at a temperature of 612° F., and by alloying the lead with tin in varying proportions, as explained in the table below, an extensive range of temperatures may be obtained. In using such baths, cover the surface with powdered charcoal to prevent the oxidation of the molten metal.

Colour.	*Articles to be Tempered.*	*Composition of Bath.*		*Temperature in degrees F.*
		Lead.	*Tin.*	
Yellowish tint	Lancets	7	4	420°
	Other surgical instruments	7·5	4	430°
	Razors, etc. ..	8	4	442°
Pale yellow ...	Penknives, and some implements of surgery	8½	4	450°
Straw yellow ..	Large penknives, scalpels, etc. ..	10	4	470°
	Scissors, shears, garden hoes, cold chisels, etc. . ..	14	4	490°
Brown yellow	Axes, firmer chisels, plane irons, pocket-knives, etc.	19	4	500°
Light purple ...	Table-knives, large shears, etc.	30	4	530°
Dark purple ...	Swords, watch-springs, etc.... ..	48	4	550°
Clear blue ...	Large springs, daggers, augers, fine saws, etc.	50	2	558°
Pale blue ...	Pit saws, hand saws, and some springs .	Boiling linseed oil		600°
Greenish blue	Articles which require to be somewhat softer	Molten lead		612°

Preserving Piano and Organ Keys.—The appearance of many a good piano and organ is spoiled by the discoloration of the keys. Where children have played upon them with sticky fingers, merely to wipe them with a clean duster will not always suffice; a moist washleather will be better. The yellowish-green colour of composition keys is mostly due to playing with damp, perspiring hands, this being most strongly marked at about the centre of the keyboard. Much discoloration without corresponding signs of wear can generally be traced to absorption of moisture from the fall or lid; the instrument being kept closed for long intervals the keys are shut up in the dark. It is then advisable to leave the keyboard portion open more, sunlight being a splendid bleach. This applies with equal force to ivory or composition keys. The use of powerful bleaching agents as nitric or sulphurous acids, or salts of lemon, is not advised; there is always a risk of allowing such solutions to flow between the keys on to the woodwork, thus causing the wood to swell and, in some cases, the keys to bind or stick together. Besides, most bleaches require several days, sometimes weeks, to be effective. The most that can be advised is to cleanse frequently with benzine or benzoline, which in many cases will restore the colour. For anything beyond this the keys should be removed from the instrument so that the surface of the coverings may be levelled or the discoloration taken out by the aid of a cabinet-maker's steel scraper and glass-paper. The keys then require to be repolished in accordance with the instructions on polishing ivory by the hand method given on p. 251.

Preserving Planes.—To keep planes clean and smooth in appearance the grain must be filled. Clean off the surface with a joiner's scraper and fine glasspaper, rubbing along rather than across the grain. Rub with linseed oil sparingly on a clean rag. With a wadding or flannel rub with French polish, the rubber being freely wetted at first, but moist only afterwards. The porous surface of the wood will soon become smooth, and moisture and dirt will be less likely to stick. Work until all the oil has been absorbed and a slight polish appears.

Brazing Keys.—Brazing is another name for hard soldering; the process differs from ordinary soft soldering principally in the fact that the uniting metal or spelter is not applied with a hot bit. Greater heat is required to melt the spelter than is necessary for soft solder, it being necessary to employ either a forge fire or a powerful blowpipe to make the hard spelter flow into the joint. Brazing is used where greater strength is required than can be given by soft solder, or when an article has to stand a degree of heat that would cause soft solder to melt. In brazing together the broken parts of a key stem, first it is necessary to file the fractured ends quite true; this may entail the shortening of the key by ¼ in. or ½ in., and as another ¼ in. will be lost in making the joint, it may be advisable to use another key bow having a longer piece of stem than the one which was broken off. With a warding file cut a dovetail on each of the ends to be joined, as shown by Fig. 1. A small, half-round file will assist in making the edges true and square. The pieces must interlock perfectly, and when this is the case, very lightly hammer the joint, around which then bind seven or eight turns of brass wire to act as spelter. Wet the joint, sprinkle powdered borax on it (this is to serve as the flux), and, holding the key in a pair of tongs, place it in a clear part of a forge fire made with charcoal, small coke, or coal cinders, and commence to blow steadily the forge bellows or blower. Failing a forge fire, use a blowpipe, the key being placed on a piece of charcoal or pumice-stone whilst the heat is being applied. A blowpipe for brazing requires a greater pressure of air than can be given by the mouth, so the blowpipe must be connected to a blower. The air pressure regulates the temperature of the flame, and to get a sharp, concentrated heat, an air pressure of from 1 lb. to 1½ lb. on the square inch is required. Such a pressure is obtained easily from a foot blower. If the forge fire is used it is as well to support the key on a guard of thick iron plate having a hole in its centre over which is the joint to be brazed. By this means the necessary local heating is obtained, and much labour in cleaning the key afterwards is avoided. On being heated, the borax swells and boils up, and should be pressed down with a spatula, previously dipped in cold water to prevent the hot borax adhering to it; a suitable spatula is made by flattening one end of a 1-ft. length of a ¼-in. round rod, having at its other end an eye by which it may be hung when not in use. With this spatula, also, powdered spelter may be added to the joint if required. When the brass wire commences to run, assist the flow by adding powdered borax, and when all the brass has run into the joint, rub off superfluous molten metal from underneath and allow the joint to cool gradually. When cold, file up and clean the stem of the key until only a thin bright line of brass can be seen. Fig. 2 shows the finished key.

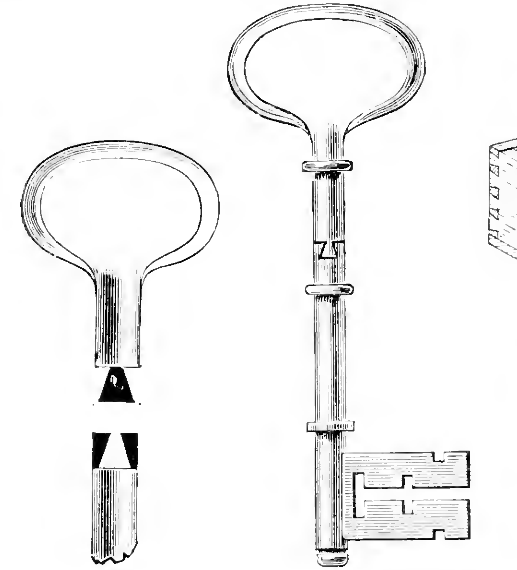


FIG. 1 FIG. 2
Brazing Keys.

Making Glass Blowpipes for Blowing Birds' Eggs.—To make glass blowpipes for blowing birds' eggs, hold in the gas a piece of glass tube and gently rotate it with the fingers. When the tube is hot, draw the two ends gently apart until they separate. Break off the sharp point of the glass to obtain two blowpipes.

Flower Window-box.—Fig. 1 shows the construction of a flower window-box. The wood should be about ¾ in. or 1 in. thick, according to the size of the box; the angles should be dovetailed and nailed together as shown. The bottom is simply nailed to the sides and ends. The appearance of the box is considerably improved by mitring and fixing a moulding round the front as shown; and tiles can be fitted to the front with bolection moulding, which is rebated as in Fig. 3. Two or three wedge-shaped strips should be nailed on the bottom as shown at A (Fig. 2); they require cutting to the splay of the sill; this allows of the box standing level. It is a good plan to paint all the joints and parts of the box that will be in contact before fixing them together.

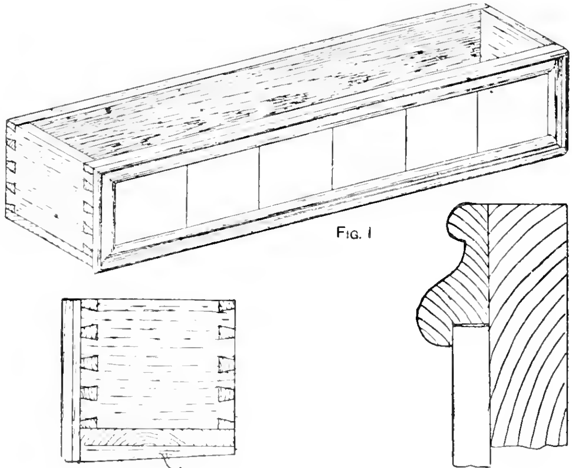


FIG. 1 FIG. 2 A FIG 3
Flower Window-box.

Cleaning Wash-leather Gloves.—One method of cleaning wash-leather gloves, if they are not much soiled, is to well rub them with bread crumbs. Another method is to damp about 1 pt. of bran with water, and with this well rub the gloves whilst on the hands. When the gloves are quite clean, get 1 pt. of hot, dry bran and work this upon them till they are quite dry. A third method is to syringe the gloves with benzoline and hang in the air to dry. A slight working, shaking, or stretching will remove any slight stiffness. Still another method is to put the gloves on the hands and well wash in soap and warm water. When quite clean wipe with clean cloths (the gloves need not be rinsed), and finish by working in hot bran.

Cleaning an Ormolu Clock-case.—Presuming that it is desired to clean the gilt case of the clock, the movement must first be taken out. Unscrew the bell at the back, and take off the pendulum. Undo the two screws at the back rim that hold in the movement, and draw the clock out from the front. The gilt case will be found to be made of many pieces held together by nuts and screws inside. Take it all apart and get every piece separate. Then well wash with a plate-brush or soft tooth-brush, using hot soap and water to which soda has been added. Rinse thoroughly in clean water, hot first, and then cold. Let the parts drain, and dry them thoroughly in warm, dry sawdust before a fire. Then dust off the sawdust with a soft brush. In putting the parts together again, handle them with a clean duster or a leather.

Constructing a Small Counter.—Figs. 1 to 4 show the construction of a simple form of counter. The front and ends are made of ¾-in. narrow matchboards; these are fixed at the bottom to a 6-in. by ¾-in. board, the latter being mitred at the two outer corners. The top ends of the boards can be fixed round the inside to a 2-in. by 1-in. fillet as at A (Fig. 4). The back of the counter can be prepared for drawers if desired, as shown at Figs. 3 and 4. This framing should be mortised and tenoned together, and the runners for the drawers fixed to the framing, and also to a fillet to the front as shown at Fig. 4. The top can be secured by screwing into it through the fillets A. A piece of prepared moulding fixed round the top of the plinth and under the top, as shown at Figs. 1, 2, and 3, will greatly improve the appearance.

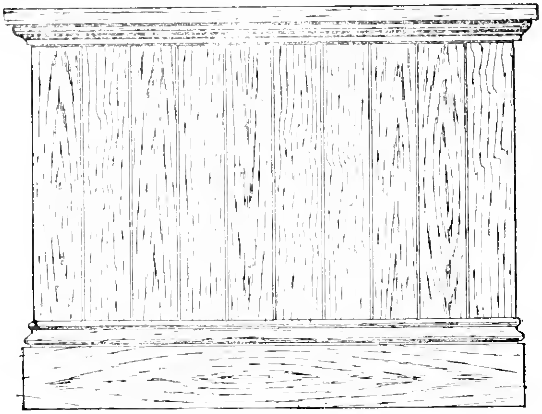


FIG. 1

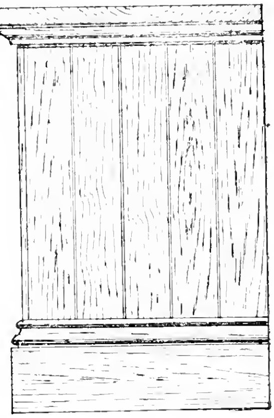


FIG. 2

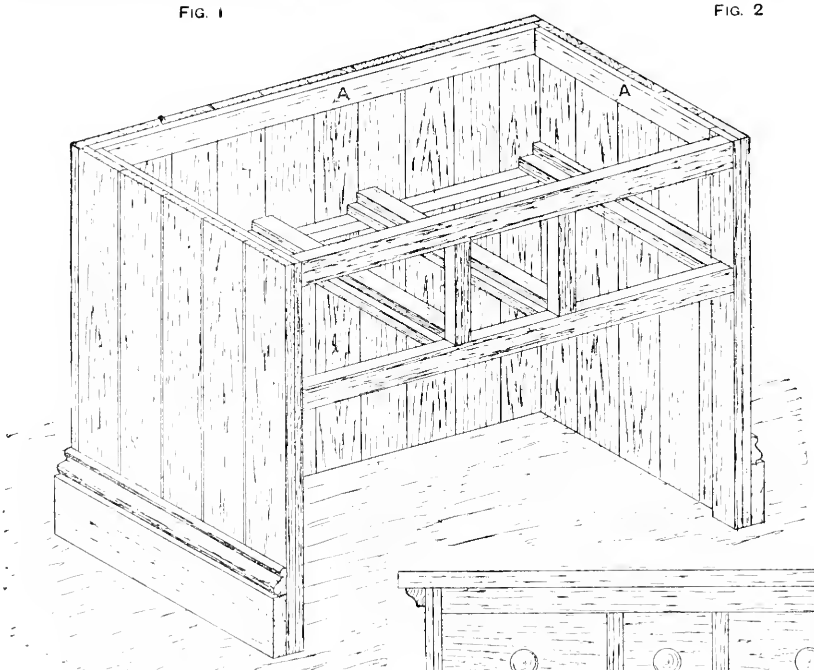


FIG. 4

Constructing a Small Counter.

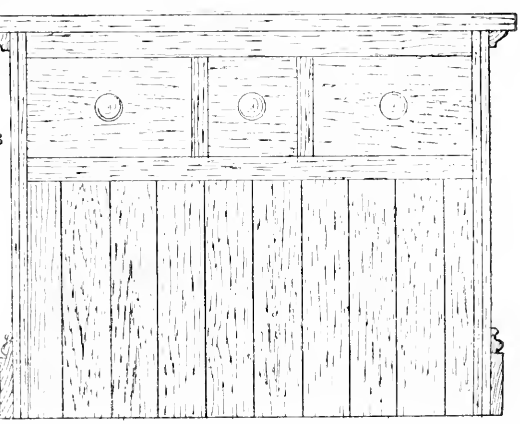


FIG. 3

Cheap Electro-gilding Solutions.—Several attempts have been made, but without success, to invent a cheap electro-gilding solution for metal jewellery. Much, however, may be done with copper anodes; these may be so worked in the ordinary gold cyanide solution as slightly to alloy the deposit of gold with copper, and thus give a pleasing blush to a thin film of the precious metal. The cheapest method of preparing these solutions is to dissolve pure sheet gold in a solution of potassium cyanide by means of current from a battery until a test sample receives a nice blush of gold in a few moments' exposure. The articles must be clean and well polished, lightly scratch-brushed, strung on wires attached to the negative pole of the battery, and dipped for a few moments in the gilding solution; then rinsed in clean hot water, and brushed with a scratch-brush of very fine soft wire.

Black Varnish for Grates and Stoves.—In the spring, when fires are dispensed with, it is the custom to coat the grates, stoves, fenders, and other ironwork attached to fireplaces with Brunswick black in order to save the trouble of constant blackleading. This gives a bright, glaring appearance, and in some instances presents a surface that is difficult to blacklead again. This is more difficult if the blacklead is mixed with turpentine. A varnish free from both of the above objections may be made as follows. Dissolve 4 oz. of common shellac and 2 oz. of resin in 1 pt. of methylated spirit, and add ½ oz. of black aniline dye, soluble in spirits, to give it a rich black colour. Should there be any difficulty in obtaining the dye, gas black may be used. This can be obtained by boiling a pot or kettle over a gas burner, hanging it so that it nearly touches the burner. The fine jet black which forms at the bottom of the pot or kettle should be removed when cold, and mixed with the varnish—sufficient to give it a good black colour. The above gives a fairly bright surface, which can be dulled by omitting, or reducing the quantity of, the resin. It should be applied with a camel-hair brush.

Cause and Prevention of Halation in Negatives.—The word halation signifies a "halo" or mist of light that surrounds and confuses the outline of an object. Halation is caused when some of the light that enters the camera passes through the film on the plate and is reflected from the back surface of the glass. Abney shows that a ray of light R (Fig. 1), passing through an emulsion containing particles of silver bromide P^1, is not only reflected against P^2, but, after passing through the glass at an angle, is again reflected to P^3 as shown by the shaded portions in Fig. 1. Halation may be prevented by coating the back of the plate with some

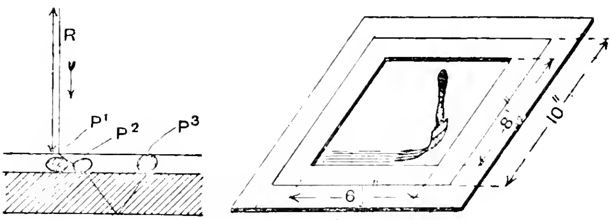


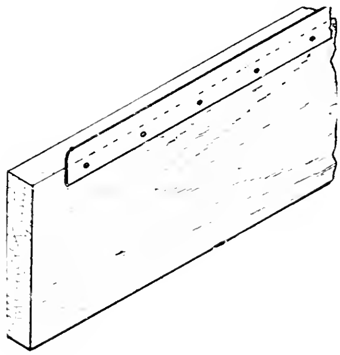
FIG. 1 FIG 2

Halation in Negatives.

preparation capable of absorbing light. A good anti-halation mixture is composed of caramel 1 part, burnt sienna 2 parts, gum 1 part, and alcohol 2 parts. This preparation is applied to the back of the plate with a brush. The plate may be conveniently held in a frame similar to that shown in Fig. 2. Cover the table with a sheet of clean blotting paper, and on this place the frame, which should be provided with carriers so that it may be used for any size of plate. Lay the plate, film side downwards, in the opening and rapidly brush over the back with the backing mixture. The backing, if properly prepared, dries rapidly. The backed plates should not be placed in the slides until the backing is thoroughly dry, otherwise dust will afterwards be found in the slide. Before developing the plate the backing should be rubbed off with a damp sponge. Most brands of plates may now be obtained ready backed. In taking interiors, dark trees against the sky, and, in fact, whenever strong contrasts are shown, backed plates must be used.

Steel-facing Electrotypes.—A film of pure iron of such hardness as to resemble steel (hence the process is named "steel-facing") may be deposited on the face of an electrotype. The solution for the purpose is made as follows. Dissolve 1 lb. of iron sulphate (green vitriol) in ½ gal. of rain water, and add a solution of ammonium carbonate until all the iron has been precipitated. Wash the precipitate by pouring on water and allowing to settle, finally draining off all water possible. Then dissolve the wet precipitate in sulphuric acid to make a saturated solution, and use this as the depositing solution. As the solution has a tendency to become acid by working it, this must be corrected by using an anode plate of pure iron eight times larger than the electrotype to be faced, and placing a plate of platinum in the solution, attached to the iron anode, when the solution is not at work. Another solution, suitable for large operations, is made as follows. Dissolve 56 lb. of ammonium carbonate in 35 gal. of water. In this place a large anode of charcoal iron, and a small cathode of the same connected with a battery, and dissolve iron into the solution until a test strip of copper is nicely coated with iron in a few minutes. Work this, and all other iron solutions, with a weak current—a battery of Daniell cells will do—keep the anode clean, and add free ammonium carbonate as required. The voltage necessary to work any solution and give best results must be found by experience always bearing in mind that iron solutions yield their metal in best condition at a low voltage. Iron solutions are also liable to change from atmospheric influences, the iron in solution being oxidised by contact with light and air. To minimise this trouble, keep the solutions covered. If a moderately thick coat of iron is desired the electrotype must be taken out every four or five minutes, and the face scrubbed in clean water, then replaced in the bath. When the coat is thick enough it should be well washed in hot water and rapidly dried, then oiled and brushed over with benzine. If not used at once it must be protected from rust by coating with a film of wax. The above process is applicable to metal articles other than electrotypes.

A Simple Boot-rack.—To make an easily constructed boot-rack, procure a piece of any kind of well-seasoned wood, rough or planed, 1 in. to 1¼ in. thick and of any breadth from 5 in. upwards, the length varying with the number of pairs of boots to be held. Make a pencil line or gauge mark ½ in. from the upper edge of the outside face of the board. The bottom edge can be beaded or chamfered. Next procure a strip of sheet-copper, brass, or tin of the required length and 1 in. broad, having the upper edge slightly roughened or milled with a small three-cornered file. Punch holes about 2 in. apart and $\frac{3}{16}$ in. or ¼ in. from



A Simple Boot-rack.

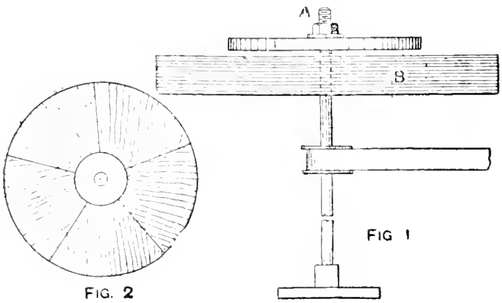
the lower edge, and set this edge to the mark on the board; ½ in. of the width of the strip will then project. Fasten it with copper tacks or small brass screws, as shown in the illustration. The rack must be permanently secured in place, and can be painted, stained, or left rough. The boot hangs vertical, the heel catching in the plate.

Colouring Portland Cements.—To make Portland cement red, mix with it mineral red oxide of iron in the proportion of 5 to 10 per cent. by weight. The best plan will be to mix a small quantity by way of experiment, and increase or reduce the quantity as may be found desirable. For a brown colour, cover the cement after it has set with a wash made as follows. Dissolve 1 part of sulphate of iron (green copperas) in 3 parts of water; this may be applied with a turk's-head or a flat whitewash brush; the concrete should then be allowed to dry in the open air. If, when the work is thoroughly dry, the colour is not dark enough, give a second coat. If alum be added to the green copperas solution, the cement becomes of a pale yellow ochre tint; while if chrome alum be added to the copperas solution, the cement work will become green.

Box Gutters on Roofs.—The box gutter of a roof is parallel from end to end, and has upright (instead of sloping) sides, the latter being formed by the pole plates on which the bottom ends of the common rafters rest. A box gutter may be between the pole plate and a parapet wall, or between two roofs sloping to a gutter between them. The ends of the bearers for the sole of the gutter are housed into the pole plate for an inside gutter, and one end into the pole plate and the other resting or notched into a wall plate when the gutter is next to a parapet wall. Such gutters should be not less than 1 ft. wide, so that a person can walk in them without stumbling or treading on the eaves of the slates. The fall of the gutter should be about 2 in. in 10 ft., and the drips should be not less than 2 in. deep

Making Cushion for Gig.—The bottom canvas of a round-cornered cushion for a gig should be cut out by the top pattern of the driving-box, sufficient being allowed for turnings, etc. To get the shape of the corner, bend a piece of stiff paper or floorcloth round the edge of the box from the centre of the seat at the back to the sham door at the front, marking round both top and bottom edges, and cutting out the material to whatever depth of cushion is required. The side and front also are governed by the size and sail of the seat; the top is cut to the pattern of the bottom canvas, allowance being made for the sail out at back and side, and for the fulness for the pleats and seams. In making up the cushion, seaming cord is usually worked into the seams, the cushion being made inside out, a space being left at the back bottom edge for stuffing. To do this, turn the cushion right side out, and fill it with whatever material is used, working it well to the front and sides to preserve the shape. Then sew up the back and tuft it down equal, and tie the bottom buttons securely with a double slip knot to prevent them becoming loose.

Wheels for Bevelling and Polishing Glass.—Fig. 1 shows the construction of a wheel used for bevelling and polishing glass; Fig. 2 shows the wooden wheel in its iron frame. The first wheel is of cast-iron, the second wheel is of clear stone, free from anything that would scratch the glass, and the third wheel is of wood. All the wheels



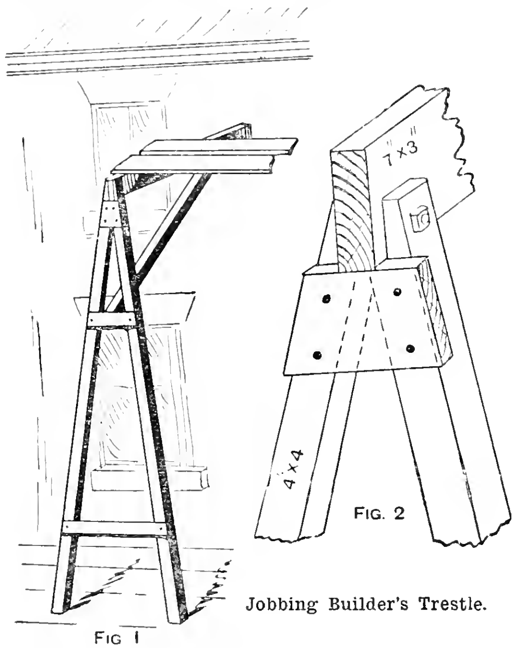
Wheels for Bevelling and Polishing Glass.

can be made to fix on the same spindle at A, which is upright; the wheels lift off and on, and are fastened down by a collar and a nut. On the iron wheel, which cuts the bevel to the size required, sand is used. The stone wheel is fed with water only, and the wooden wheel, which polishes and finishes the glass, is fed with putty powder. The tray B receives the water and sand which fall from the wheels. The wooden wheel, which must be made of willow, is fitted in sections into an iron frame wheel, moulded to shape; the wood should be about 4 in. thick, and the sections will hold themselves in place.

Cleaning Oily Bottles.—Wash oily bottles in warm soapsuds in which some washing soda has been dissolved. Should the oil still cling to the bottles, shake into them, along with the soap and water, a little fine shot. After washing in clean water, rinse the bottles with a little methylated spirit, pouring it from one bottle to another; then put them on a sloping rack to drain, mouth downwards.

Black French Polish.—If ornamental articles are to be finished in black and gold, woods may be used that are devoid of figure or fancy grain, such as canary wood, light walnut, or mahogany. Other soft woods may be used; but spruce and common deal require a great amount of labour and polish to avoid the grain swelling and a ridgy appearance. Articles likely to receive much handling and wear should first be stained; the chemical stains sold at most druggists' or veneer stores are more cleanly in use than the old-fashioned logwood stain. It will often suffice to brush the articles with black ink or, better still, with a solution of black aniline dye in methylated spirit. Black polish is generally made by mixing a small quantity of spirit aniline black dye in white, that is, transparent, polish. The work is bodied up with this, then finished with transparent polish, the proportions for which are white shellac, 6 oz.; methylated spirit, 1 pt.; and aniline black spirit dye, ¼ oz. White shellac is not dissolved easily, and may be replaced with white shellac garnet shellac, a dark ruby or liver coloured variety. If skill in polishing is not possessed, use a black varnish made as follows. Garnet lac, 1 oz.; resin, 2 oz.; gum benzoin, 2 oz.; methylated spirit, 1 pt.; and black dye, ½ oz. Dissolve the mixture by gentle heat and frequent agitation, strain it through fine muslin before use, and apply with a camel-hair brush. Before gilding is attempted, the polishing should be complete; if it can stand a couple of days, so much the better. The portion desired to be gilt should be carefully coated with japanners' gold size. The gold, procurable on transfer paper cut into convenient sizes to prevent waste, may be pressed into position when the gold size is tacky—that is, nearly dry, or after the lapse of about half an hour. Gold adhering where not desired may be removed by gently rubbing with a piece of cloth slightly moistened with turpentine. As a rule, gilded work is not polished.

Jobbing Builder's Trestle.—The jobbing builder's trestle here illustrated is useful for odd jobs of repairs to eaves, gutters, windows, and other work. Two trestles, made as shown in Figs. 1 and 2, are placed in position leaning against the wall, and two or three planks are placed across so as to form a scaffolding. The trestles are



Jobbing Builder's Trestle.

made from 16 ft. to 18 ft. in height, and if wanted higher for any special job the legs are easily lengthened by fishing on extra lengths at the bottom. They are placed with the foot farther away from the wall than the head, so that the weight of the trestles keeps them in place.

Polishing and Frosting Aluminium.—The British Aluminium Co. recommend the following methods of treating aluminium. One method of polishing is to place in a bottle equal parts by weight of olive oil and rum, and shake until an emulsified mass results; this is used as an ordinary polishing paste. A second method is to mix together fine emery powder and tallow until a paste of suitable stiffness for use with a rag mop is formed; a final polish of great brilliancy is given by using rouge and turps on the mop. A third method is to use Vienna chalk on an ordinary chamois skin buffing-wheel, and finish with rouge; or to use a rag mop with very finely powdered Vienna chalk. For frosting, the dipping bath is prepared as follows. In an iron vessel dissolve 1 part of caustic soda in 9 parts of cold water, and add about one-quarter of a part of common salt. This solution is then heated, but must not boil. The article is plunged for from fifteen to twenty seconds in the bath, so as to become nearly black on the surface and covered with air bubbles; it is then washed freely in cold water, well scrubbed with a fibre brush, again dipped and washed, then placed in a slate, aluminium, or earthenware vessel containing concentrated nitric acid until the metal becomes quite white. Again rinse in cold water, and finally dry in warm dry sawdust. Metal thus treated takes a very beautiful matt, which keeps for an indefinite period in the air and has a silky appearance, and the frosted aluminium does not blacken the hands.

Removing Grease Stains from Black Cloth.—To remove grease stains from black cloth, mix together a small quantity of fresh ox-gall and a little carbonate of potash; spread the mixture over the stains and brush with a hard brush, then wash out with clean water.

Distinguishing Woods.—To distinguish between spruce (or whitewood) and yellow deal (or Baltic redwood), the difference in colour should be noted. In the redwood, the lines that constitute the figure are a light tabac colour, or golden brown. If the wood is extra resinous, the lines are translucent. The intervening parts of the layers are cream. In spruce the "red" lines are much less distinct, though nearly similar in colour. But the colour is paler, and the lines are never translucent. The intervening layers are quite white, giving the wood an altogether whiter appearance than in the redwood. If the planks are weathered and discoloured, notice the knots. By reason of a difference in the branching habit of the two trees that furnish these woods, a great variation is noticeable in the dispositions of the knots as they appear in the planks. In the whitewood tree (the spruce fir) the branches are small, and strike out from the trunk approximately at right angles. This causes the knots in whitewood to appear as perfectly circular areas or else of an elliptical shape, the long way or major axis of the ellipse being at right angles to the grain of the wood (see A, B, C, Fig. 1). When freshly planed, the knots are a pink fawn in colour. They are irregularly distributed through the wood. In the redwood tree (the Scotch fir), the branches shoot upwards more, and the knots are consequently inclined in the wood. Figs. 1 and 2 show the comparative difference. They are, besides, more regularly disposed, and are mostly found in groups together, at distances of 1 ft. to 2 ft. apart, as shown at D, E, F (Fig. 2). This feature is prominent in the poorer grades of this wood. The knots are amber or deep brown. Archangel whitewood is obtained from the same kind of tree as Baltic whitewood. There are therefore no structural or other differences between these two, except that of quality (and size), due to better selection, soil influences, and, perhaps, climatic conditions. The only guide in this case is an acquaintance with the market forms, shipping marks, and brands, etc., that apply to each. Yellow pine is an American wood, usually handled in larger and shorter planks than each of the preceding. The wood is a light straw colour, and much finer in the grain than either white or yellow deal. The "red" line in this wood is scarcely perceptible. The knots are few but large, and often loose and black. An expert will distinguish these woods by their odour; sometimes the grain of a piece is so false that there is (except under the microscope) no other ready means of identifying it. Help will be afforded by noting the difference in weight. White deal weighs about 30 lb. a cubic foot, yellow deal about 33 lb., and yellow pine about 28 lb.

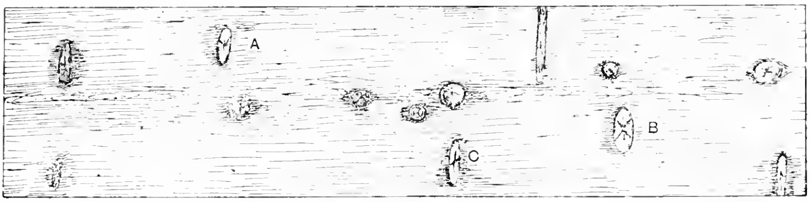


Fig 1

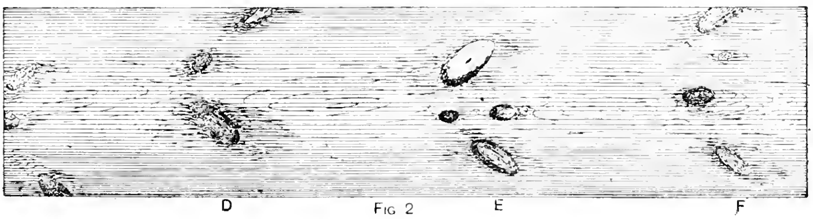


Fig 2

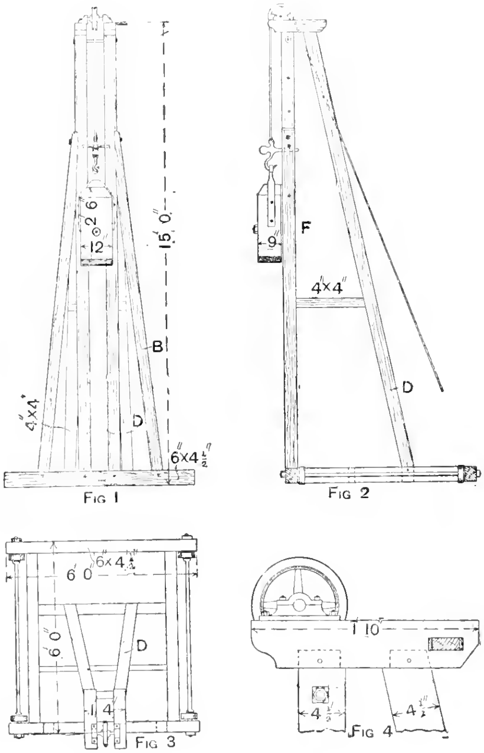
Distinguishing Woods.

Photographic Enlargement on Carbon Paper.—Enlarged negatives may be made on bromide paper by giving a very full exposure and developing a deep image. After drying, wax the back of the print well and heat it over a stove until the print is thoroughly impregnated with the wax; then iron the print flat between blotting-paper. The most satisfactory method, however, when a carbon enlargement is to be made (and the method employed by all professional workers), is as follows. From the small negative a carbon print is first made on special transparency tissue squeegeed down to a sheet of glass coated with insoluble gelatine and developed as usual. The glass is prepared by coating it with a 10-per-cent. solution of gelatine, immersing in a 3-per-cent. solution of bichromate of potash, and exposing to the light. The carbon process gives excellent transparencies capable of rendering the finest detail. Instead of using bromide paper, the transparency is enlarged in the usual way (except that the glass side of the transparency must face the enlarging surface) on to a wet collodion plate made as under. Procure 10 oz. iodised collodion, 2 oz. nitrate of silver, 1 oz. ferrous sulphate, 2 oz. acetic acid, and 1 oz. alcohol. A new glass plate of the required size must be cleaned thoroughly by rubbing with alcohol, and then coated with collodion as in varnishing a negative. Directly the collodion has set, the plate may be lowered into the silver bath, which should consist of 35 gr. of silver nitrate to each 1 oz. of distilled water. If the dish containing the bath is flat and level, 25 oz. of solution can be made to suffice for a 20-in. by 15-in. plate. After exposure (care being taken to guard the wet film from dust and to keep the drained corner at the lower level throughout), the still wet plate is flowed over with the developer until the image is well out, when the plate is immersed in a fixing bath of hypo. The developer consists of ferrous sulphate 10 gr., acetic acid 20 minims to each ounce of distilled water, with sufficient alcohol to make it flow easily. Considerable practice is necessary before plates of this size can be worked successfully. The development of a 20-in. by 15-in. plate is best carried out in a dish, instead of holding the plate in the hand as in small work. Porcelain dishes larger than the largest plates likely to be used must be provided, and the one containing the silver bath must be retained for that especial purpose. Collodion film, unlike gelatine, is extremely tender, and will not bear touching; even a strong flow of water is sufficient to disturb it. It is advisable, though not absolutely necessary, before collodionising, to coat the plate with a filtered mixture of the white of one egg, 4 drops of ammonia, and 1 qt. of water.

Staining Baskets.—Several kinds of stains and varnishes are used for baskets. Most stains are applied after the baskets are made. Brown japan thinned with turpentine will give a mahogany colour. See that the baskets are thoroughly dry, then give a coat of the japan applied with a brush. When dry, give a second, but somewhat thicker, coat. Another method of producing a mahogany colour is to give the baskets a coat of gum thus dissolved in water. When dry, brush over some bichromate of potash dissolved in hot water. Finally, give a coat of shellac varnish. Still another method is to boil some logwood chips, or extract, in water, then carefully add some sulphuric acid; this can be either poured over or brushed on the baskets. When the baskets are dry, finish by coating with shellac varnish as before.

Re-blackening Bent-wood Furniture.—In renovating bent-wood furniture, first remove grease, etc., by scrubbing with strong soda water. When dry, smooth down with No. 0 glasspaper, then apply with a camel-hair brush several coats of combined black stain and varnish (see p. 195) or of black enamel having a spirit varnish basis. Allow at least an hour to elapse between the application of successive coats.

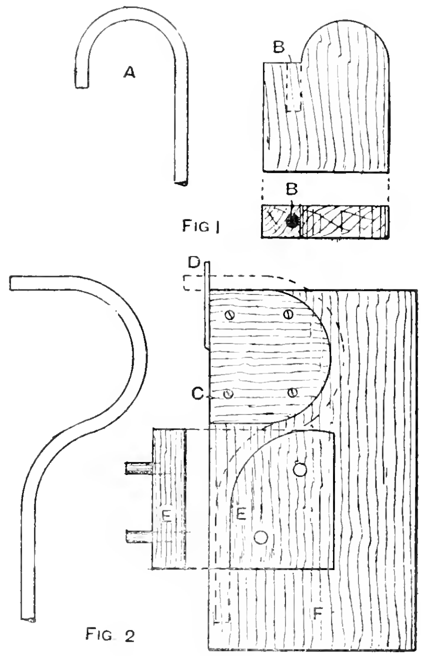
Construction of a Pile-driving Engine.—The accompanying illustrations show a pile-driving engine suitable for driving piles 14 ft. by 6 in. by 2 in., with a ram of about 1½ cwt., to be raised by manual power. The base frame shown in Fig. 3 is composed of four 6-in. by 1½-in. red deal sills, stub-mortised and tenoned together, and secured by two ¾-in. bolts that can be made to do duty for axles for the wheels, if wheels are used. The two guides for the ram are 1½ in. by 1¼ in., and are tenoned



Construction of a Pile driving Engine.

and pinned into the head and sill frames; the girders are kept parallel by a ¾-in. bolt just below the head. The front raking braces B are of 4½-in. by 4½-in. stuff, and are bridle-notched to the guides, and secured with ½-in. coach screws. The back braces D (4 in. by 4 in.) are tenoned and pinned into an intermediate sill, framed between the main sills about 4 ft. back, and when a platform is used an additional joist is framed in as shown to stiffen the floor (this floor is omitted in the illustration). The head frame is constructed as shown in Fig. 4; a 4-in. by 3-in. rail is framed in at the rear end, and collars are welded on the bolt E to keep the distance parallel. The gin or pulley runs in a casting bolted to the top of the frame. The ram, if made of greenheart of the given dimensions, will weigh 1½ cwt.; but if made of Jarrah another 9 in. in length will be required; the lower end of the ram is bound with a wrought-iron flange 1 in. by ½ in. The trip, or monkey hook, shown in the illustration is one of the best of its kind; several ½-in. holes are bored in the guides before framing them in, and a ½-in. iron bar is placed at any height from which it is desired to drop the ram. As soon as the arm of the monkey reaches the bar, it is tripped out of the eye of the ram, which immediately falls; the counterweight on the front of the hook tilts it down again ready for entering the eye when it is lowered. F is a slider attached to the ram to prevent it jumping away from the guides. If there is much work to be done with the engine it will be advisable to bolt ¾-in. by 1½-in. iron bars on the face of the guides to prevent wear. Figs. 1, 2, 3 are reproduced to scale of 1¼ in. to 1 ft.; Fig. 4 is to a scale of 2 in. to 1 ft. Another design for a pile-driver is given on p. 165.

Bending Small Tubes.—To bend a number of pieces of, say, ¼-in. brass tube as A (Fig. 1), cut a piece of hardwood as oak or beech, 1 in. thick, to the curve required, and in it drill a small hole B. In this hole one end of the tube is inserted; the tube is then bent round the block. Before this, however, one end of the tube should be stopped, or it may be pinched in the vice. It should then be filled either with melted resin and pitch or lead, the latter being the better, as the tube is less likely to buckle. Several lengths of tube may be bound together with wire and annealed at the blowpipe or forge. The seam of the tube must be inside the bend. A bender which has a movable block E is shown in Fig. 2. The base F may be 1-in. or 1½-in. deal, but the piece C should be of ¾-in. oak,



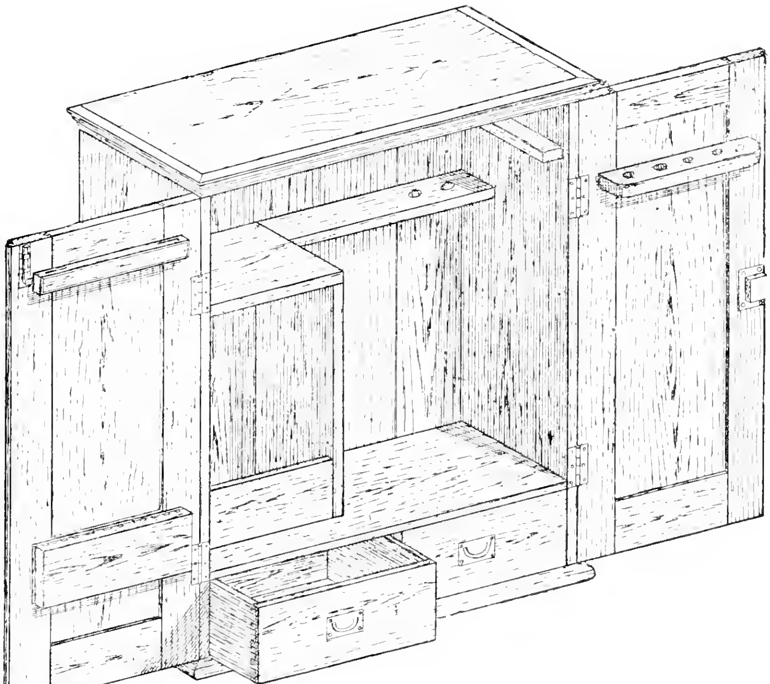
Bending Small Tubes.

beech, or similar hardwood firmly screwed to the base. A strip of iron D, 1¼ in. wide by ⅛ in. thick, is screwed, and a hole drilled in it serves to hold the tube firmly while being bent. The piece E has two ⅜-in. iron pins tightly driven in and projecting ¾ in. as shown, holes being drilled for these in the baseboard. First insert an end of the tube in the iron strip and bend the tube round and underneath; then put the block E in place and bend the tube round it as indicated. A piece of wood 6 in. long, 3 in. wide, and 1 in. thick is screwed in the centre of the baseboard underneath and is pinched in the vice; it holds the block firmly while being used. Brass wire may also be bent by the same means, but the blocks need not then be so strongly made. Brass rings can be made with a parallel iron mandrel; on this the wire is wound. It can then be taken off and cut up with a circular saw, and brazed or otherwise joined.

Preserving Tortoise Shell.—In preserving the shell of a tortoise, first it is necessary to remove the carcase from its shell. Cut the skin along the top and bottom of the front and rear parts. Then, with scissors or a knife, disconnect the limbs and neck as far inside as possible. With a penknife and a piece of bent wire, remove all the flesh and internal organs; then wash the inside of the shell with a strong solution of carbolic acid or a saturated solution of alum. Now hang it up to dry. The outside of the shell is given a good appearance by washing, and, when dry, either French-polishing or varnishing it. Files, glasspaper, etc., must not be used, or the shell will be spoilt.

Varnish on Door Turning White.—Door varnish which "blooms" or turns white in wet weather, probably was left uncorked for some time, or had been stored in a damp, cold place and become chilled before being applied to the door. If the defective varnish on the door is sufficiently hard, it should be "flatted"—that is, rubbed down to a dull level surface with second grade pumice-stone powder and water, using a pad of horsehair, hair cloth, or canvas. Swill off with plenty of clean water, then in warm dry weather apply a coat of varnish of a different brand from that previously used.

Cupboard for Carpenter's Tools.—The accompanying drawing shows a cupboard that will be suitable for holding carpenter's tools. A useful size would be about 2 ft. 6 in. wide, 3 ft. high, and 11 in. deep; but the dimensions may be varied according to requirements and number of tools to be stored. One-inch material will be suitable for the sides, bottom, and top, and also for the stiles and rails of the doors. The panels of the doors should be of ½-in. stuff, and the back of ⅝-in. thick boarding, grooved and tongued; matchboarding will answer the purpose. The shelves and drawer fronts may be of ¾-in. stuff, and the sides, back, and bottom of the drawers of ½-in. stuff; these are finished sizes. Forms for racks are shown; these can be fixed where desired. The compartment on the left is for planes, etc.

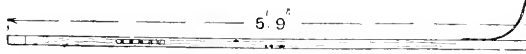


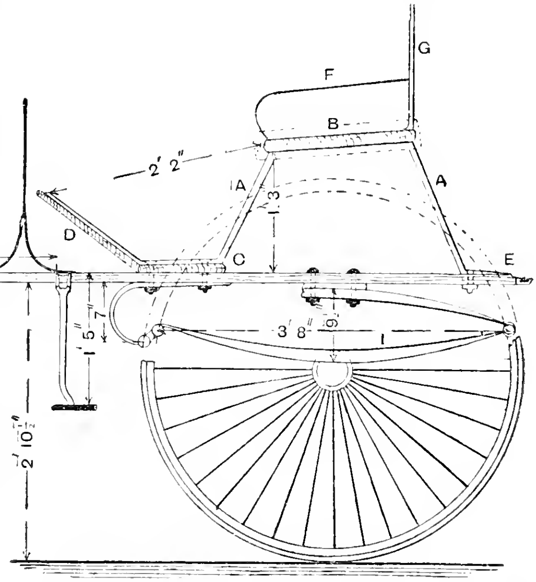
Cupboard for Carpenter's Tools.

Modelling Materials and Method of Construction.—In making a model of a small tract of country showing, on a large scale, the intersection of road and railway, modelling clay may be used if the model is to be somewhat rough in its nature, is required for a temporary purpose only, and is to be used within a short distance of the place where it is made. The drawbacks to the use of modelling clay are its want of permanency, the difficulty of moving the finished model, and the absence from it of the natural colours of the objects represented; the advantages are facility of execution and cheapness. If the model is to be of a more or less permanent character, or if it has to be moved about from place to place, the structure may be built up of wood and plaster-of-Paris; these materials can be painted to indicate the natural colours of the objects represented. If a quantity of small detail has to be clearly shown, modelling wax may be recommended. This wax is of a soft and plastic nature, and remains permanently so, thus forming an excellent substitute for wet clay; it must, of course, be protected from rough usage; modelling wax is supplied in various colours. Another material that may be used is plasticine, which is an imitation of modelling wax, but is only made in one colour (a greenish grey); plasticine is quite as pleasant to handle, and retains its plasticity in the same manner as wax. The ordinary method of constructing a model is as follows. Surround the required surface area with a wooden frame, making the frame rather deeper than the probable thickness of the intended model. The frame will present the appearance of a shallow wooden box, for which a cover either of wood or glass, as may appear most desirable, may be constructed. The bottom of the box must be of a substantial character, and should be stiffened with cross-pieces or battens; handles should also be provided and firmly connected with the bottom or foundation board. The sides of the box may be of ½-in. stuff. In this box the clay is placed and worked roughly to shape, and is then trimmed carefully with spatulas and modelling tools. Grass may be indicated by powdered moss sprinkled on a coating of glue, and cinders, etc., by painting the place with Indian ink; railings, bridges, buildings, and structures of that kind can be formed of timber stuck into the clay. When a model is made of plaster-of-Paris the elevated portions of the structure are usually filled with "hollows," which are rough boxes made of ½-in. stuff sprigged together and fastened to the foundation board. On these hollows, which greatly lessen the weight of a model, the plaster is laid with a spatula or small trowel, and is worked as nearly as possible to the form required. Bridges should be fashioned in timber and fixed in position before anything else is done. Buildings may be cut out of wood and fastened down with wire nails, which should be long enough to reach the foundation board. The railway metals may be made of strips of wood. Plaster-of-Paris mixed with water sets in about nine or ten minutes; if that time is not long enough for shaping the contour of the model, the setting of the plaster may be retarded for a further ten minutes by mixing white of egg with the water (5 per cent. of white of egg to 95 per cent. of water). Errors in construction, however, are easily corrected after the plaster has set. Surplus material is readily removed with a joiner's chisel and a light mallet, and additions may be made by roughening the surface of the plaster, well wetting it, and adding as much fresh plaster as is necessary. The model may then be painted either in oil or in water colours. Railings, signal posts, etc., may be let into holes drilled in the plaster. For trees, those supplied in a box of children's toys may be employed.

Preserving Lamb's Foot.—To preserve a lamb's foot for the purpose of making a whip stock, the whole of the inside of the foot must be taken out. The shank bones should be removed without cutting the skin, but a cut above the hoofs at the back will be necessary in order to finish. If this cannot be followed, cut straight down the back, and remove the bones, but be careful when the hoofs are reached. Knocking the outsides of the hoofs with something hard will frequently release the bones. Now dress the insides with a solution of 4 parts of burnt alum to 1 part of saltpetre and neatly sew up; then fit in the stock and wrap some string round. When quite dry, remove the string and fix a ferrule. Very often the work is less thoroughly done. The shank bone is merely removed without cutting the skin, and the stock fitted in. The foot is then bent if desired to be curved, and the whole hung up to dry in a draughty place. The tendons and muscles are allowed to dry naturally, but eventually, especially if put in a damp place, the whole becomes offensive.

Making a Trotting Sulky. — The accompanying sketch shows a side elevation of a very light sulky suitable for a cob 14½ hands high. The oval iron stays A are made with a flap at the top end, to which the seat B is fixed; the front stays at the bottom are made of half-round iron, in the form of a bracket, being fixed to a light landing board C which extends upwards to take the footboard D. The hind stays at the bottom E may be fixed on top of the shafts, and have an ell flap to go on a bar framed across between the back end of the shafts. On the front edge of this bar a light iron stay should be fixed, sweeping round to get a fixing on the inside of the shaft, just behind the spring bearing. The seat B is 1 ft. 5 in. wide by 1 ft. 10 in. long, and has light iron rails fixed at the ends as F. The back-rests G should be made of steel, with a loop at the top to take a broad leather strap. The shafts H may be of hickory or lancewood, 10 ft. 9 in. long over all, 2 in. wide by 1¼ in. thick, with a side cant of 4 in. The springs I are of the elbow pattern, with a slight return sweep at the front end,





A Trotting Sulky.

hung by shackles to a light scroll made of spring steel. The wheels are 4 ft. high, and may be of the pattern shown; or a light Warner wheel may be put on. The step is 1 ft. 5 in. deep from the top of the crown to the top of the tread, and is fixed to the shafts and bar by two $\frac{5}{16}$-in. bolts. The draught or whiffle-tree bar should be attached to the cross-bar, to which the steps are fixed, either by a centre-bolt or by two leather straps, and kept in position by two breeching staples. The rein rail is fixed on top of the shafts at such a height as to keep the reins clear of the horse.

Damp Wall Remedies. — If the wall affected by damp is not of great extent, the most effectual remedy is to cut out the old brickwork in small portions at a time, and rebuild the wall with Staffordshire blue bricks set in cement; or ordinary stock bricks may be used, with a cavity between the inner and outer skins. If the wall is only 9 in. thick, this would necessitate either thickening the wall or making the inner skin of brick on edge. If it is not desirable to pull down and rebuild, line the inside of the wall with thin lead paper, Willesden paper, or Callender's sheet bitumen.

Staining or Dyeing Ivory Billiard Balls. — The process of colouring ivory billiard balls by immersion in water stains requires close attention that the balls may be withdrawn directly the required tone is obtained, and therefore only two or three balls can be dyed to precisely the same colour at one operation. They are prepared for dyeing, first by polishing with whiting and water, washing off the whiting, and immersing for from three to five minutes in a mixture of 1 part of commercial muriatic acid or nitric acid and 50 parts of water; this dilute acid extracts the gelatine from the surface of the ivory, and this is essential to the production of a uniform colour; the surface of the ivory is injuriously affected if the acid is not sufficiently dilute. The utmost cleanliness is necessary, and all touching with the hands must be avoided; lift the balls by means of a pair of wooden tongs. Before transferring to the stain, immerse for some minutes in clean cold water that has been boiled. The water stain should be at a temperature of 100° F. The higher the temperature, the more rapidly is the stain taken, but results obtained at the temperature mentioned are certain, and much greater heats are liable to injure the surface of the ivory balls, which then would have to be re-turned in the lathe. The ivory is removed from the stain from time to time until the required tint is obtained; times of immersion cannot be stated with exactness, as some ivories take the stain more readily than others. On removal from the stain, well rinse in clean cold water, even though the ball has yet to pass through a bath of a different colour. Always transfer balls from the stain to clean water. When dry, polish the balls by rubbing with a clean soft rag on which have been sprinkled a few drops of oil; finish with a dry clean rag, removing all the oil. Filter or strain all the stains given below before use. The stains may be made as follows. Black: (1) Make a strong solution of silver nitrate. After an immersion of several hours, the balls are removed and exposed to a strong light. (2) Boil a handful of logwood chips in 1½ pt. of water until the liquid is reduced to ¾ pt. Allow to cool to 100° F., and after staining, place the balls for five minutes in a solution of 1 oz. of sulphate of iron in 1 qt. of water. (3) Make a decoction with water and 1 lb. of galls and 2 lb. of logwood. The balls require a long immersion in this, and afterwards an immersion of a few hours in acetate of iron. Blue: (1) Make a dilute solution of indigo sulphate containing potash or tartaric acid. (2) Dissolve verdigris and sal-ammoniac in dilute nitric acid; afterwards dip in a strong solution of pearlash and water.
Brown: Five minutes in logwood water stain gives warm brown; half an hour, a deep chocolate brown; a ten minutes' immersion, washing, dipping in pearlash solution for one or two seconds, and again washing, a deep red brown; by substituting a minute immersion in an alum solution for the pearlash a deep purple brown is obtained. Green: Saffron or fustic stain, followed by an indigo one; fustic is more permanent than saffron. Red: (1) Infuse cochineal in liquor ammonia. (2) A solution of nitro-muriate of tin, followed by a hot decoction of 1 oz. of logwood in 1 pt. of water. (3) A decoction of brazil for fifteen minutes, followed by a solution of nitro-muriate of tin, or by a solution of pearlash for a few minutes. (4) Boil a piece of shredded red cloth about 1 ft. square together with 10 gr. of pearlash in ½ pt. of water for five or six hours. The pearlash may be left out, and afterwards 1 part of sulphuric acid may be added for every 65 parts of stain. An immersion of three to five minutes gives a pink colour; an immersion of two or three hours a crimson red colour. Yellow: (1) Boil 60 gr. of saffron for some hours in ½ pt. of water; this is a fugitive stain. (2) A more permanent one is made by boiling 4 oz. of fustic dust and chips in 1 qt. of water. The yellow colour can be given an orange tint by immersing the stained balls in a brazil water stain, and the orange colour may be deepened to a redder tone by passing the balls through a solution of nitro-muriate of tin.

Making Cheap Bicarbonate of Soda.—Bicarbonate of soda is made by passing carbonic acid over carbonate of soda until the material is saturated. It can be home-manufactured as cheaply as it can be bought.

Cleaning Oil Lamp Burner.—In cleaning an oil lamp burner all gauze or perforated parts should be well brushed. These parts cannot be thoroughly cleaned by boiling, and it is often impossible to brush them in the ordinary way. In such a case a pointed piece of wood, with the end broken and made like a brush, could be used, though this process is rather tedious. The perforated parts of the burner may look clean, but if not carefully done there may be left a matting of fine hair or fibre material, which will prevent the air passing through freely. If insufficient air passes through, combustion becomes imperfect; the burner also becomes dangerously hot. Dirty burners cause lamps to smoke.

Grocer's Hoist.—Figs. 1 and 2 show a side and end elevation, respectively, of a goods hoist suitable for a grocer's use. The hauling rope is an endless band of any desired length, and works a 3-ft. flywheel with a V-rim that actuates the winding drum, the ratio being 1 to 7, so that a man can easily raise 6 cwt. A self-sustaining hoist should be used; this will suspend the load at any point, and allows one man to do both the

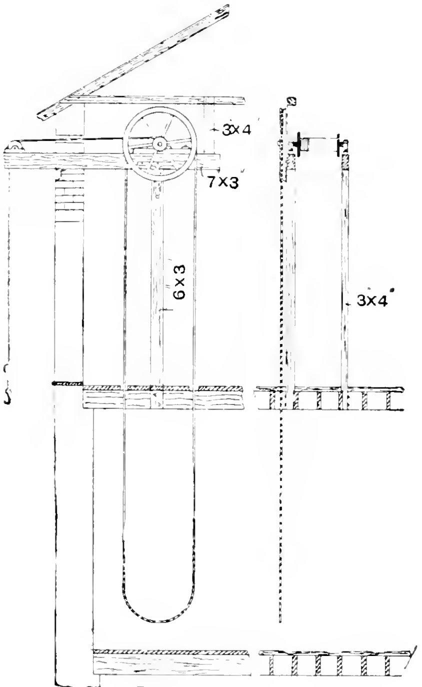


FIG 1 FIG. 2

Grocer's Hoist.

hauling and the landing. The cat-head projects about 2 ft. from the wall, and should rest on a wood or iron template about 2 ft. 6 in. long, to distribute the pressure. The inner end may be brought in any convenient distance for mounting the bearings of the hoist, and should be framed into a post by mortise-and-tenon joint. If a beam in the roof is convenient, a stud may be fixed near the end as shown, or the cathead may be secured to the post by an iron strap bolted to the sides. The post should be notched and bolted to the side of a floor joist. A similar beam and post of lighter scantling is required to carry the bearings of the opposite end of the hoist, as shown in Fig. 2. The outer end of this beam may rest in a chase about 2½ in. deep cut in the wall.

Blocking Out on Glass Positive.—In blocking out some figures from a glass with oil or water colour, the positive should be mounted with its glass side outwards, otherwise the image would be reversed. If the positive is so mounted, there will be no danger in painting over it with oil or water colour. The figure may, of course, be painted out on the film side of the positive; but in such a case, care must be taken in cleaning off, as a collodion film is exceedingly tender, and a good plan would be to soak the positive in turps, and then stroke the paint gently with a tuft of cotton-wool. Another plan for getting rid of a figure is to cut for it a mask in tissue or tracing paper; or the blocking out may be done on a glass cover placed over the positive. In each of these methods the work is out of focus, and a hard, sharp blocking-out line around the figure is avoided; but if the outline is very intricate, and the tone of the background differs considerably from that of the figure, the painting-out method is best. Figures are sometimes blocked out with a No. 1 retouching pencil after rubbing over the glass with retouching medium in the usual way. Fancy backgrounds, etc., then can be introduced.

A Small Blowing-fan for a Forge.—For a blowing-fan to be used with a small forge the base may be of ½-in. deal to the shape and dimensions shown by Fig. 1. The two deal sides (Fig. 2) form a gradually increasing space for the air inside the fan. The vanes at A almost touch the tin covering, but from that point the space gradually increases until B is reached, where it is 4 in. wide. Screw the sides to the base at its narrowest part with a distance of 3½ in. between them. Each side has two circular holes 4 in. to 5 in. in diameter; across these, pieces of sheet-iron 7 in. by ¾ in. are screwed, each iron having a hole in the centre to take a bushing of brass tube in which the spindle runs. A disc of wood 2 in. in diameter has a central hole bored to fit the spindle, and four ½-in. holes are drilled at equal distances on the periphery of the disc. Four pieces of wood,

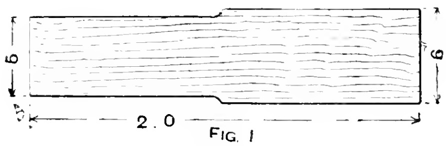


FIG. 1

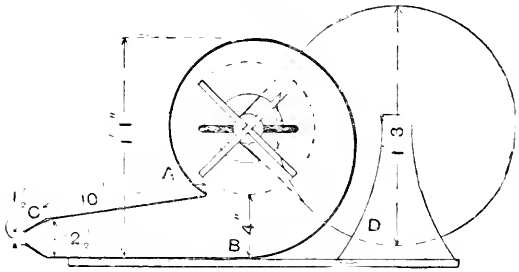


FIG 2

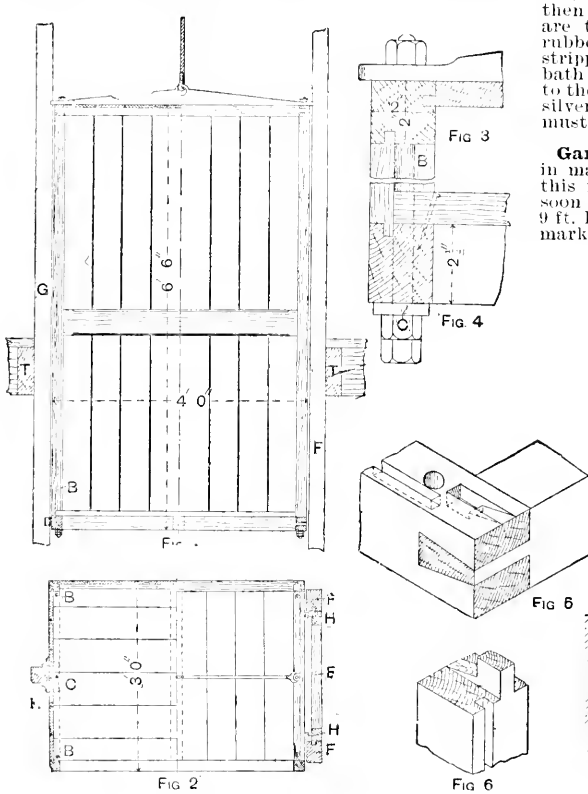
A Small Blowing-fan for a Forge.

¾ in. square and about 4 in. long, are tapered on the ends to fit these holes; each carries a vane of stout tin about 3½ in. square. The fan can now be mounted on the spindle, the vanes being trimmed to fit as close as possible to the sides of the case without touching. To prevent side-shake, solder two brass collars on the spindle. Enclose the fan by tacking a sheet of tin 4½ in. wide completely round the case from C to B (Fig. 2), and make a tin nozzle tapering to about 1½ in. square and attach it at C. Now make a bracket D, about 9 in. high, on which to mount an iron pulley about 15 in. in diameter; by this a belt drives a pulley 1 in. in diameter placed on the end of the fan spindle. The fan should now be painted and finished.

Polishing Granite.—Granite is polished in many different ways, the method employed depending upon the nature and quality of the granite, the varieties of which are very numerous. The following method is the one generally adopted. The surface left by the axe presents a succession of ridges and furrows; these ridges must be rubbed down with iron rubbers and sharp coarse sand and water. When all the tool marks are removed, and an even face has been produced, the rubbing is continued with emery powder of varying degrees of fineness, the same iron rubbers being used. Lastly, the stone is rubbed with a woollen or linen boss on which fine flour emery is sprinkled and moistened with water, the final polish being given with putty powder (oxide of tin) and a felt block. A good polish, which can be obtained only by persistent rubbing, will keep its lustre undimmed for half a century at least. For the sake of speed and cheapness, hydrochloric acid (spirits of salts), oxalic acid, and similar acids are sometimes used for polishing; but the polish soon disappears, and the face of the granite is to some extent destroyed.

Making Resin Paste.—Resin must be dissolved before it can be added to flour paste. Dissolve 1 lb. of washing soda in 1 gal. of water, then add 2 lb. of resin in powder and boil until the latter is dissolved. This solution may be used in place of part of the water required for making the paste. Should this not be satisfactory, dissolve the resin in turpentine and stir it into the warm paste.

Construction of a Goods Lift.—The accompanying illustrations are intended to explain the construction of a goods lift, to be worked by hand, and fitted with balance weights. The extreme dimensions of the lift are 4 ft. wide, 3 ft. deep, 6 ft. 6 in. high; this is the largest size usually made to work by hand, and it is capable of carrying safely 10 cwt. If the lift is to be used by passengers, safety catches and another guide should be added. The construction is simple, and consists of a skeleton frame of 2-in. by 2-in. stuff, filled

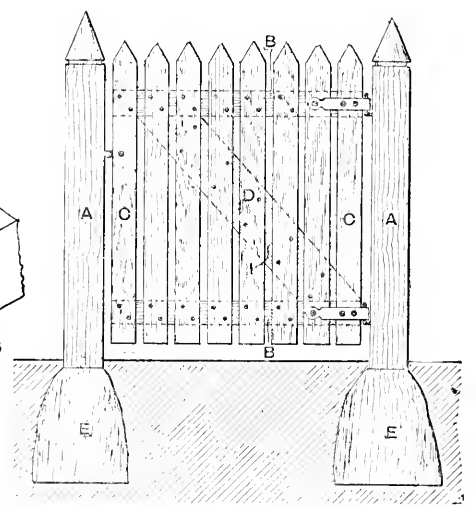


Construction of a Goods Lift.

in with panels of $\frac{3}{8}$-in. matchlining. The top and under frames are dovetailed together at the corners as shown in Fig. 5, the pins being on the front and back rails in order to prevent the cage spreading in this direction; the guides prevent the cage opening in the other direction. The corner studs are stub-tenoned and table-haunched into the frames, and kept in position by four $\frac{3}{8}$-in. wrought-iron bolts B running from top to bottom of the cage. The matchlining is fitted into $\frac{3}{8}$-in. grooves in the frame, on three sides and the top; the floor is formed of 1-in. boards, nailed on the under frame, and running in a direction transverse to the top; a rail $4\frac{1}{2}$ in. by 1 in. runs across the back to strengthen the matchlining. The cage is hung to a wrought-iron rail $\frac{3}{8}$ in. by 3 in., spread at the ends, and drilled to receive a bolt that runs through to the bottom, where it beds on an iron plate C (Figs. 2 and 4). The end of this rail may be forked over the guide post G, Fig. 1, to form a runner. F F are the balance frame guides. E is the frame, which is filled in with cast-iron weights. H H are pieces of $1\frac{1}{4}$-in. by $\frac{3}{4}$-in. oak, fixed to the side of the cage to form runners; or, if preferred, iron bracket pieces, as at K, may be used. T T show the trimmer joists around the openings. These cages are usually made of good sound yellow deal, painted or stained, and varnished; but for a goods lift that is in constant use, it is advisable to make the frame and guides of oak or teak. Fig. 1 shows a half vertical section and half front elevation; Fig. 2, a half plan and half horizontal section; Fig. 3, an enlarged section through the top corner of frame; Fig. 4, an enlarged section through the bottom corner of the frame. Fig. 5 shows the joints at the corner of the frame, and Fig. 6 the method of tenoning the posts.

Stripping Silver from Copper.—If the copper article is small the silver may be stripped by immersion in hot concentrated sulphuric acid, to which nitrate of potash crystals must be added in small quantities as the work proceeds. The acid must be kept hot in a porcelain or vitrified stoneware vessel. The article to be stripped must be dry and free from grease, lacquer, or varnish. It must be gently moved whilst in the acid and closely watched, and must be taken out and rinsed in clean water when the silver has been removed: the acid will then not deeply corrode the copper, which may then be polished in the usual manner. If the articles are too large to be thus treated the silver must be rubbed off in the process of polishing. Silver may be stripped from other metals by electrolytic action in a bath of potassium cyanide, with the article connected to the positive pole of a battery or dynamo, and a small silver plate connected to the negative pole. The article must be removed as soon as all the silver is dissolved.

Garden Wicket Gates.—Garden wicket gates are made in many kinds of timber, but chiefly in oak and pine; this must be dry and well-seasoned, or the gates will soon warp and wedge. A good width is 3 ft. 6 in. A piece 9 ft. long by 3 in. by 2 in. is sawn in two for the sides, marked C in the illustration. The palings D are $\frac{1}{2}$ in. by



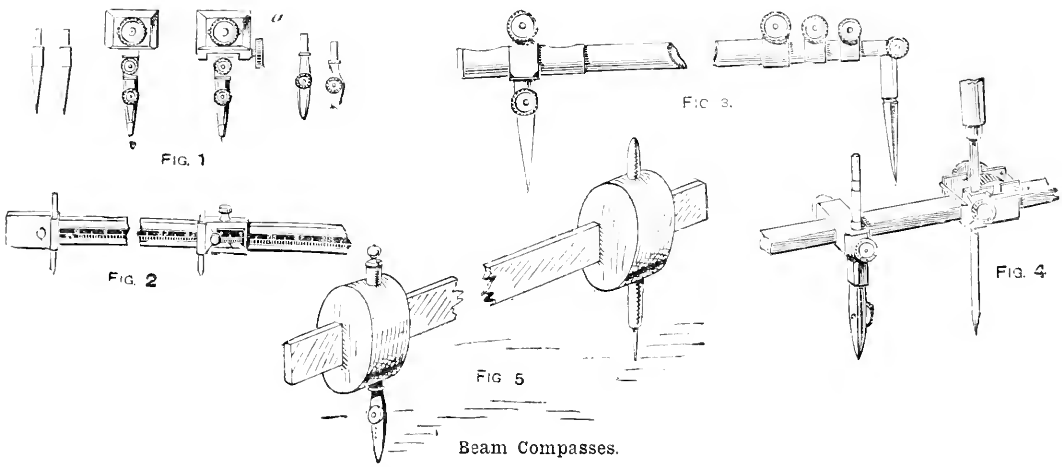
Garden Wicket Gate.

3 in., nailed to cross bars I; both the long bars B are mortised into the sides C, and are glued and painted in putting together. The posts A are of oak, 5 in. square, the ends E being left rough as shown. Before being put in the ground they are given two coats of red lead. All the woodwork is given two coats of red lead and painted afterwards.

Deoxidising Tin.—To deoxidise tin, stir into it while in the molten condition plenty of sal-ammoniac or resin, and continue adding either of these substances until the tin appears in its usual state; then skim the dross from the surface, and cast the metal in sticks or ingots of the required size.

Forming Grooves in Cement Floor.—A grooved cement floor, say, for a stable, is laid in sections, and the deep part of the grooves is formed by inserting laths in the wet cement, the rounded portion between the grooves being obtained by cutting off with a trowel, before withdrawing the laths, the arrises at the edges of the grooves. After the cutting is done and the laths are withdrawn, the concrete is carefully smoothed with properly shaped moulds. For the proper performance of the work considerable dexterity and skill are required, as the whole operation must be completed before the cement has begun to set.

Beam Compasses.—A beam compass is used for the purpose of drawing circles or arcs of longer radius than can be taken in by the ordinary bow compass. A beam compass usually consists of a flat wooden beam fitted with two movable trammel heads such as are illustrated by Fig. 1. As is shown in the illustrations, these trammel heads carry interchangeable pen and pencil points, and dividers or needle points, and are secured to the beam by large clamping screws. The beam itself is usually a flat lath of hard wood, and when this lath is very long considerable inaccuracy may be caused by its deflection sideways. To prevent such deflection, the beam should be made of T section. In using the beam compass, the heads are adjusted approximately to the required distance, and are clamped in that position by the screws mentioned above; the exact distance is then adjusted by means of the fine adjusting screw lettered *a* in the illustration. Fig. 2 shows a beam compass, with a graduated beam, as used in the Ordnance Survey Department. To the fine adjustment is fitted a vernier scale, by which it is claimed that the distance between the heads can be regulated to the hundredth part of an inch. In Fig. 3 is shown a telescopic beam compass having several tubular parts sliding one within the other, and clamping screws to fix them at the desired position. A very neat and useful beam compass is that shown in Fig. 4, in which the beam is about ⅜ in. square. One of the heads is clamped to the beam, and serves to carry the pencil point, at the other end of which is the pen. The other head is held in position by the pressure of a strong spring, which presses a fluted roller against the top of the beam. A milled head at the side enables the draughtsman to rotate the fluted roller and so traverse the head along the beam to the desired position. A makeshift beam compass may be made out of a blind lath and two good-sized corks, such as are used in pickle bottles. Holes are burnt and cut for the reception of the lath and drawing pen as shown in Fig. 5, and also for the pricker or needle stuck into a penholder. The cork takes a good grip of the lath, and the instrument is quite steady and pleasant to work with.



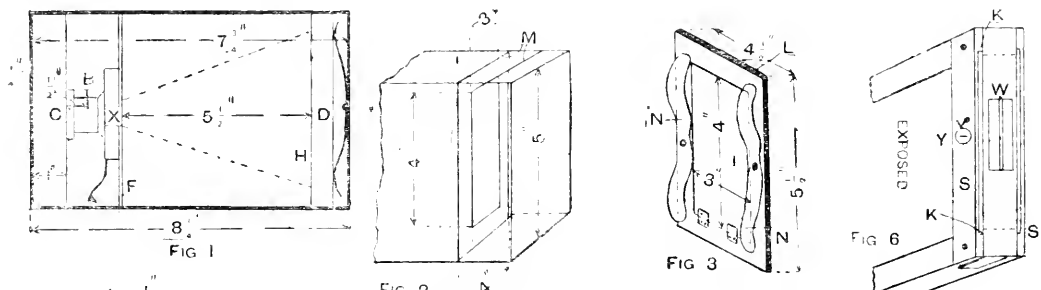
Beam Compasses.

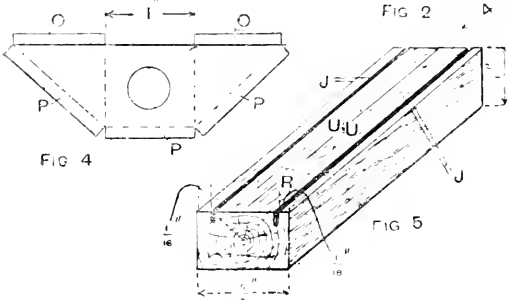
Bacterial Treatment of Sewage.—No hard-and-fast rules can be laid down for the construction of bacterial filters, this method of treating sewage being of comparatively recent date. Any kind of tank that will hold water may be used. In some towns shallow pits with sloping sides have been excavated in the earth, the bottom and sides of the pits being lined with clay puddle. But such an arrangement can only be considered as a temporary makeshift; for permanent work the tanks are generally lined with concrete or blue bricks. Many bacterial filters have been made by utilising existing precipitating tanks at sewage treatment works. Experience tends to show that the depth of a filter tank should not exceed 4 ft. The size of the filters should be so proportioned to the amount of sewage to be treated that not more than 200 gal. or 250 gal. per square yard of filter are dealt with; and at least three sets of filters should be available, in order that each filter may be worked in an eight-hour cycle—that is to say, approximately, three hours for filling, two hours for standing quiescent while the bacteria are doing their work, one hour for drawing off the effluent, and two hours standing empty for aeration. Each set of filters should consist of a coarse filter and one or (preferably) two fine filters. A site should be chosen that will allow of the effluents being discharged from the bottom of the first filter on to the top of the second, and from the bottom of the second filter on to the top of the third. The materials generally used for filling the tanks are—for the coarse filters on to which the sewage is first discharged, coke or clinkers of, say, 2-in. gauge; and for the fine filters, coke-breeze or screened cinders, of not larger gauge than ¼ in. and not finer than ⅛ in. Coal slack, burnt clay ballast, and other materials have been used with success for the body of the filter. It must not be forgotten that the tanks, when supplied with filtering material, will only hold about 40 per cent. of their original capacity. The raw sewage, before it is turned on to the filters, should be passed through a screen of some kind, otherwise rags, corks, cotton-waste, and other matters that are not properly sewage, and therefore not amenable to treatment, will be deposited on, and clog up, the surface of the filters. It is a great advantage to have a large tank, of a capacity sufficient to hold, say, half a day's sewage, in which a preliminary sedimentation and putrefaction may take place; the effluent from such a tank is in a much better condition for filter treatment than fresh sewage. It is a usual though not an invariable practice to lay at the bottom of the filter-beds a central line of drain-pipes with open joints, and radiating lines of smaller pipes, also open-jointed, arranged herringbone fashion. Various contrivances are used for keeping the bottoms of the filters as open and accessible to air as possible. One device is to have the bottoms lined with two courses of bricks, the lower courses having open spaces of about 2 in. around each brick, and the upper course being close-jointed to keep the filtering material from being washed out. Unless a free supply of air can be made to circulate through the whole body of the filter after each emptying, there is not a chance of success.

Whitening Stone Stairs.—For whitening Portland or Painswick stone, pipeclay should answer well, but should be sparingly used—that is, just a smear rubbed on evenly with a wet rag. Or a piece of soft Bath stone (Corsham or Farleigh Down for preference) might be used; it should be rubbed on with a little water and finished with a wet rag. Ordinary hearthstone (Godstone), sold and used for the special purpose of whitening stone, might be tried. Either of the substances mentioned above ought to answer the purpose. The mistake that is generally made is to put on too much of the whitening material, hence it flakes off in places and has generally a rough appearance; whereas if a little of it were carefully and thoroughly rubbed into the stone the result would be satisfactory.

Making Caulked Joints.—The method of making a caulked joint in a cast hot-water pipe is first to caulk the space about one-third full of hemp, then put about half an inch of putty, then a ring of hemp, then another ring of putty, and so on until full, finishing off with the putty. It must then be allowed sufficient time to harden before letting the water in, or the swelling of the first hemp will squeeze the lead back. Ordinary putty should not be mixed with white and red lead; the two latter ingredients only are used. Badly made and leaky joints cannot be remedied; they must be picked out and re-made as described above.

Making a Hand Camera.—In constructing a hand camera, first fix up a suitable lens of about 5½-in. focus in a box, ascertain exactly the principal focus, and see, also, whether the lens covers a ¼-plate satisfactorily; that is to say, with a stop having a diameter equal to one-eighth the focus (or about ⅝ in.) the lens should give a sharp image right to the extreme corners of the plate. The principal focus, plus the distance from the stop B (Fig. 1) to the edge of the hood C, and the width of the slide D, ¼ in. for springs, together with an allowance of 1 in. focal adjustment, should constitute the inside length of the camera. Having constructed the framework, fix the lens board F at the required distance, which is found by focussing a very distant object on a piece of ground glass placed exactly ¼ in. from the back. Next fit a frame at H, and remove a portion of the top of the framework at M (see Fig. 2) to allow of the insertion of the slide. Construct the frame L (Fig. 3) with springs N to force the frame into accurate register and fit the door I, through which the image may be focussed on a celluloid focussing screen. This screen consists of a light frame to carry a sheet of celluloid, the screen sinking into a rebate gauged to match that of the slide. The front door is next fitted, and carries two finders, a pattern for which appears in Fig. 4. The lenses are let into the front by sinking a hole of the





Making a Hand Camera.

diameter of the lens to within one-sixteenth of its total thickness, and then cutting a smaller hole. After dropping the lens into its recess the lens may be held against the shoulder so formed by springing in a rim of wire. The edges O, O are bent over, and a bend is also made along the dotted lines. The frame formed by the bent pieces carries a strip of looking-glass on the parts P, and is screwed to the front door, so that the hole covers the lens. The focus of these finder lenses should, proportionately to the screen, be slightly less than that of the chief lens, so that the image in the finder can be blocked out until it coincides with that on the screen. A piece of ground glass is fixed beneath O, O. The frame H (Fig. 1) should be covered with velvet, so that when the slide is inserted through M (Fig. 2) the springs force it against H and make a light-tight join. Dark slides may be bought cheaply, or may be made as follows. Groove some pieces like Fig. 5 (two 5 in. and two 4 in.) and dovetail into a frame, with a piece of blackened zinc fitted into a groove R to make the light-tight division. Before fitting, however, cut away the parts J from the top rail on each side, until these parts are flush with the underside of the groove. Glue a strip of velvet between the points K and K (see Fig. 6), and shape the rails S. Glue a narrow strip of black paper across just below Y to act as a light trap, and fasten a spring like it at U and U (Fig. 5). The plate rests on these springs, and is forced upwards against the top rail. When a piece of vulcanite or vulcanised fibre has been cut and fitted as the draw shutter, the ivory number inserted, and the draw strap attached at W (Fig 6), the slide is complete. The camera may be covered with Roanoid or imitation morocco. The lens must be fitted with rack and pinion, the latter to be brought out through the side of the camera, and fitted with a pointer, against which a scale of distances may be fixed. A covered nut may be let into the side and one into the bottom of the camera, so that a stand may be used when required. A time and instantaneous shutter is shown at X (Fig. 1); the principle of such a shutter is explained on p. 187. The dark slides as made above are so light that several of them, each holding two plates, may be carried in the pockets.

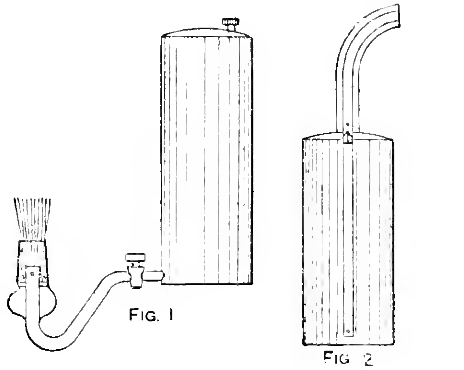
Electro-plating Lead with Copper.—To plate sheet lead with a thin film of copper first prepare the following solution. Dissolve 1 lb. of copper sulphate in ½ gal. of rainwater, then stir in enough liquor ammonia to throw down the copper in the form of a green precipitate, and dissolve this to make a blue liquid. Dilute this with an equal bulk of rain-water, then add sufficient potassium cyanide to destroy the blue tint and produce the colour of old ale. Filter the whole through calico and expose to the action of air for twenty-four hours, when it should be ready for use. Work it cold or hot with a strong current at a pressure of from 6 to 8 volts, using an anode plate of pure copper. The lead plates must be scoured clean with sand and water, then briskly rinsed in a solution of pearlash (1 lb. to the gallon), and transferred from this direct to the copper-plating solution without handling or previous rinsing in water. If the first deposit is coarse and loose, remove the plates and well brush them in water with a hard fibre brush, again rinse in the potash or pearlash solution, and return to the copper-plating bath, using a reduced anode surface, or keep the plates moving whilst being plated. In this way a bright facing of copper may be obtained, which must be well rinsed and dried quickly to prevent tarnishing. Electro-deposited copper rapidly tarnishes in air when damp.

Repairing Marble Clock-cases.—When the corners of a marble clock-case are broken off, the disfigurement may often be remedied by reducing the case, after which the polish may be restored. The procedure is as follows. File off from the damaged part as much as may be necessary, taking care, however, not to alter the original shape of the case. Then grind off the marks of the file with a suitable piece of pumice-stone with water, and then with a water-stone, giving special attention to the corners and contours. Moisten a hard ball of linen and sprinkle over it either tripoli or fine emery, and with this rub up a lustre; then rub with a linen ball, using with it finely washed emery and rouge; when dry, finish the polishing with a mixture of beeswax and oil of turpentine. This method may be used for all sorts of marble. When the piece broken off is too big, or when the fractures are too deep for the above plan to be adopted conveniently, the damaged parts may be made up with a cement prepared by mixing finely powdered marble with a little water glass. This is applied in the form of a thick paste, and, when dry, has its shape corrected by filing, a polish being obtained as recommended above. Parts broken off a coloured marble case may be cemented in place again by wetting the pieces with an aqueous solution of silicate of potash, putting them into position, and allowing forty-eight hours for the cement to dry. For white marble, egg albumen with a little Vienna lime forms the cement.

Waterproofing Small Shed.—As a waterproof coating for a small shed tar, perhaps, is the most suitable. Paint or varnish may be used, but they are not so durable as tar, and much more expensive. A paint that may be suitable can be made by melting together equal parts of pitch and resin and, after removing from the fire, thinning with petroleum ether or paraffin oil. This paint is applied with a brush.

Photographic Studio Blinds.—The method of fixing and the manner of controlling the blinds in the roof of a photographic studio depend upon the position of the studio and on the quality of the light. The blinds should be of two kinds: those next the glass should be of thin calico, the outer ones of green sateen or glazed lining. Spring rollers, provided they are properly fixed and used, give the most satisfactory method of control. Sometimes two wires are stretched across the studio and the blinds are festooned between them, but such an arrangement is very objectionable: the blinds collect dust, cannot easily be shifted, and look very untidy. A good and cheap method is to fix the blind on a roller with a pulley and cord at one end, and a cord from the centre of the bottom. Pulling down the blind winds up the cord, and pulling down the cord winds up the blind.

Reservoir for Paraffin Blowpipe.—There are two ways in which oil can be supplied from a reservoir to the burner of a paraffin blowpipe in sufficient quantity to keep up a steady flame. One method is shown by Fig. 1, the other by Fig. 2. In the latter method it would be necessary to make the reservoir rather strong, as it would have to stand a slight pressure. A little oil must first be run into the outer tube and burnt; this will warm the top of the reservoir and force the oil up the tube and through the small jet. The oil will vaporise in the hot tube and burn there, while a little escaping through the small holes in the inner tube into the outer tube will also burn there, thus tending to keep the pressure up. In



Reservoir for Paraffin Blowpipe.

the method shown by Fig. 1 the flow of oil is regulated by a tap; the oil flows through the holes in the inner tube (the top of the inner tube being closed) into the outer tube, where it burns.

Cutting Letters on Polished Granite.—Letter cutting on polished granite headstones is executed in the following manner. Set out the letters on tracing-paper (care being taken that they are evenly spaced) and paste or gum the paper on the stone, keeping the letters in line with a straightedge. When the paste is dry, nick in all the letters with a sharp chisel and remove the paper, if necessary; it is, however, sometimes advantageous to keep the paper on till the work is finished, as the paper saves the surface polish from being scratched. Another way is to cut a slice off a raw potato, make a few cuts on the flat side of the slice, and rub it on the polished surface of the stone: the potato juice dries quickly, furnishes a medium that can be pencilled on, and is easily rubbed off with a piece of damp paper. White of egg, or a very thin smear or coating of size and whiting, can be used for the same purpose. The letters are cut with small cup-headed chisels of various sizes, termed splitters; they are similar to the tools employed for cutting marble, and are used with an iron hammer. The best chisels for this class of work are made from old finely cut gulleting saw files, which are manufactured from the very best steel; these old files may be bought at a very cheap rate per hundredweight, and are easily made up by any toolsmith. The chisels should be tempered to a dark straw colour, and kept perfectly sharp; a better edge will be preserved if, after every few blows of the hammer, the chisels are dipped into turpentine; turpentine should also be rubbed on the whetstone. The edge of each letter should be kept perfectly clean and correct in outline, and the internal mitre or depth should form a right angle; the letters need not be cleaned out or finished at the bottom if they are to be leaded. For the lead or imperishable filling, cut holes in an oblique direction on the sloping side of the letters, one hole at each end and two in the centre of each member (or more, if thought desirable); use a small drill, and cut the holes sufficiently deep to key in the lead. The lead for filling in should be new sheet, as it is softer than old lead melted up; it should also be a little thicker than the depth of the letter, and should be cut into strips or cut out roughly to the shape of the letter. Lay the lead on the cut letter, and beat in with a boxwood mallet until every portion of the letter is filled and the lead well fastened, then cut off the superfluous lead with a carpenter's chisel until the outline of the letter is found; beat gently home, and bring the letters to an even surface by gritting with pumice-stone, finally finishing off with snake stone (water-of-Ayr) and plenty of water, which gives the letters a dark appearance. When the surface of the stone is polished, a brass drag with fine teeth is sometimes used to remove the superfluous lead; the drag is traversed backwards and forwards, and avoids all scratching of the polish. For gilding the cut letters, apply a couple of coats of gold size, the first coat mixed with a little yellow ochre to give a body and fill up the pores. When the second coat gets tacky, English gold leaf is applied with a small badger-hair brush and well worked into the mitres, and then cleaned off. The process of gilding, although apparently simple, requires great care and experience.

Development of Spiral Flute on a Column.—If a piece of paper be cut to the shape of a right-angled triangle and wound round a cylinder, the top edge forms a helix or spiral line, as in the accompanying

Development of Spiral Flute on a Column.

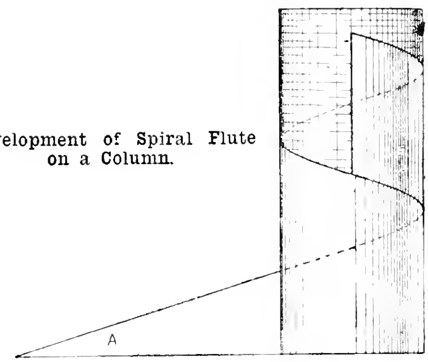
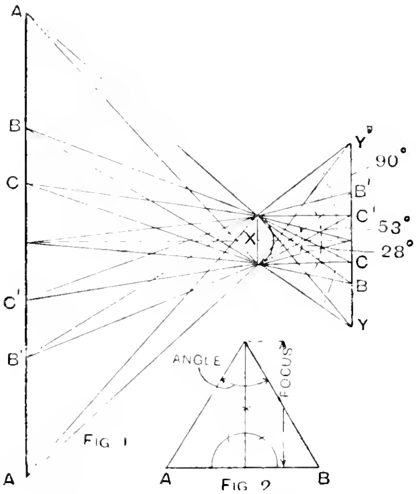


illustration. The larger the angle A, the steeper the pitch of the spiral. The simplest method of developing a spiral flute would be to first dress the shaft of the column to a cylindrical surface, then mark off the base of each flute at the lower end, cut a piece of brown paper to triangular shape to give the required pitch, wind it round the column and pencil the outline formed by the top edge. The pitch is found by making the length of the triangle equal to the circumference of the shaft, and the height of the triangle equal to the height the spiral is required to rise in one revolution.

Making Amber Varnish.—In making amber varnish, place 14 lb. of rock salt dissolved in spring water and 7 lb. of ordinary amber in a crucible over a fire till the amber is perfectly white. The bleached amber is then heated in an iron pot till entirely dissolved. When cool, the amber is taken out and well washed in spring water to eliminate the salt. It is then placed in the pot again and heated till dissolved, then poured out and spread over a clean marble slab to dry, any humidity that may remain being removed by gentle heat or sunshine. The amber is then powdered and again heated, with frequent stirring, till it is of the desired fluidity. When cool, purest turpentine in a warm state is added till the composition is of the required consistency. The gum also readily dissolves in pure chloroform, or in a mixture of spirits of turpentine and alcohol, the whole being heated for several hours in a closed vessel. It also yields to the action of sulphuric acid. The manufacture of amber varnish on a small scale without the aid of special plant is not recommended.

Restoring Polish of White Marble.—In order to impart a high lustre to white marble which has become dim, cover it with a solution of pure beeswax in oil of turpentine, and then rub dry with a linen or cotton cloth. The hard rubbing generally produces a good polish.

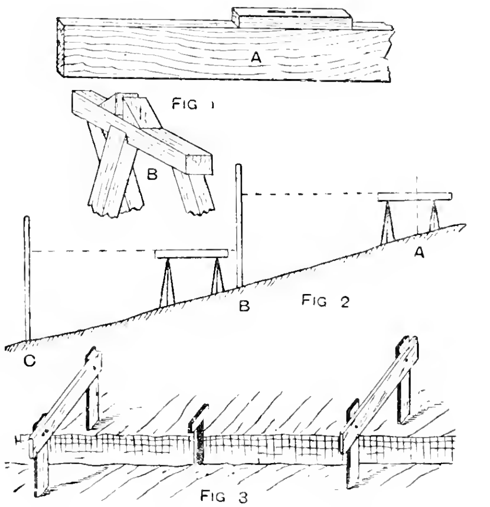
Photographic Lenses of Different Angles.—The angle of a lens refers to the amount of subject it includes in the picture, and therefore depends upon the size of the plate it is used to cover. The term is only comparative. If, for example, a wide-angle lens of 8-in. focus, intended for a 10-in. by 8-in. plate, is used to take a picture on a half-plate, the lens ceases for that specific purpose to be a wide-angle lens. When the focus of a lens is less than the diagonal of the plate for which it is used, the lens is termed a short-focus or wide-angle lens. If the focus is considerably greater than the diagonal of the plate, the lens is called a long-focus or narrow-angle lens. In Fig. 1 the courses of rays proceeding from six points and passing through a lens are traced. Those rays issuing from A and A' and focussing at Y and Y' are assumed to make an angle of 90 with X. So that if these rays were used the lens would be a wide angle. Similarly, if the rays B and B' only are included, a minimum angle of 53 would be obtained, whilst the rays C and C' give an angle of 28. The angle of a lens must, therefore, be measured as shown in Fig. 2. Draw a line A B equal to the diagonal of the plate; from the centre erect a perpendicular the length of the focus. Connecting the three outside points gives the angle. It happens, however, that if so great an angle as shown between A and A' (Fig. 1) is used, curvature of field will prevent the rays being focussed on a flat surface unless the lens is specially constructed for such a purpose. Short-focus lenses must be of small



Photographic Lenses of Different Angles.

diameter. The shorter the focus the sharper the curve, and the sharper the curve the smaller the circle, of which the surface of the lens is a segment. It must even be proportionately smaller, and work with a small stop, to cause the centre of the picture to be formed by the centre of the lens (and *vice versâ*) and prevent spherical aberration.

Setting Out Gradient of Watercourse.—Below are given instructions on setting out with an ordinary spirit level a new watercourse. Make a straightedge of wood, say 9 ft. or 10 ft. long, 6 in. broad, and 1 in. thick (see A, Fig. 1), and true up one edge accurately. Some kind of supports will be required to carry the straightedge at a convenient height for sighting along; for this purpose, a couple of roughly made light trestles (see B, Fig. 1) will do. Cleats nailed on top of each trestle make a slot into which the straightedge may be placed with its true edge upwards. Wedges are placed under one end until the spirit level, when placed in the middle of the length of the straightedge, indicates that it is level, and by looking along its top edge a horizontal line may be sighted with a fair degree of accuracy. Fig. 1 shows the arrangement. The total fall in the full length of the proposed watercourse should be ascertained in the following manner. Set up the levelled straightedge at the top of the course, as at A (Fig. 2), directing it along the intended course. Send a man along as far as can be conveniently seen, say to the point B, and let him hold up a staff perpendicularly, and in front of it a piece of white paper, such as an envelope. The man at the level, by signalling, directs the man at the staff to raise or lower the paper until the top of it is exactly in a line with the edge of the straightedge. If the staff is not graduated in feet and inches, a pencil mark may be made and the height of the mark from the ground measured. Supposing the height of the straightedge from the ground at A (Fig. 2) is 3 ft., and the height sighted on the staff at B is 4 ft. 9 in., there is a fall of 1 ft. 9 in. in the surface between these two points. The straightedge is now shifted to B, and a further sight taken towards C in the same manner, and so on until the whole course has been traversed. The sum of the whole of the falls, less any rises there may be, will give the total fall available. Suppose the fall to be 2 ft. 3 in. in a total length of 900 ft.; this is equivalent to 1 ft. of fall in 400 ft., or 1 in. of fall in 400 in., or 33 ft. 4 in. To set out this gradient on the ground, so as to cut the new watercourse to an even fall, it is advisable to have sight rails put up at distances of 100 yd. or 150 yd. apart. Sight rails are an arrangement of two uprights and a horizontal cross-piece spanning the line of the excavation in the manner shown in Fig. 3, and they are used in conjunction with a loose staff, called a boning rod, which has a small cross-head at the top. Supposing the depth of the excavation to be, for the most part, about 3 ft., a convenient length for the boning rod will be 6 ft., so that the sight rails will be approximately 3 ft. above the level of the ground. The first sight rail will be fixed at the height of the boning rod, *i.e.* 6 ft., over the starting



Setting Out Gradient of Watercourse.

point of the watercourse. Now, with a gradient of 1 in 400, if the second sight rail be fixed 100 yd. along the line, it will require to be 9 in. lower than the first one; for 100 yd. equals 300 ft., and if the fall in 400 ft. is 1 ft., the fall in 300 ft. will be 9 in. To get the correct height for the second sight rail, fix up the levelled straightedge immediately underneath the first sight rail, measuring with a rule how much it is below the top edge of the sight rail. Suppose the measurement is 14 in. Let the man with the staff mark the height of the horizontal sight line as before, and it is evident that the height so marked will be 14 in. below the first sight rail; and as the second sight rail has to be 9 in. lower than the first, then 5 in. above the point marked on the staff will be the right height at which to fix the rail. When the sight rails have been put in in this way, the boning rod is used to try the level of the bottom of the cutting, as shown in Fig. 3. If the cutting is at the right depth, the tops of the sight rails and of the boning rod will be all in one line.

Grain Fillers for Teak and Oak.—The following will be found a useful filler for most kinds of coarse-grained woods. Take 3 parts of finely crushed dry whiting, 1 part of finest grade pumice powder, and tint with brown umber; mix to the consistency of thick paint with turpentine. The pigment used for tinting purposes is varied as required. This filler will do for oak and teak, if not tinted too strongly. As both oak and teak may be termed hungry woods, the chief thing to aim at is to set the filling instead of swilling it out. Allow the goods, after filling in, to stand overnight, then start to polish with the rubber not too wet, and work out fairly dry the first two or three rubbers of polish.

Cement for Repairing Plastering.—A quick-drying plaster for repairing and patching may be made with Parian cement. It does not need time to dry, and the sooner it is painted (if in a painted wall) the better. There are two qualities, the superfine and the coarse.

Cutting a Wooden Ball inside another. — For cutting balls one inside another, sycamore, about $3\frac{3}{4}$ in. in diameter, is most suitable. Determine the top and bottom of the ball, and bore there holes $\frac{1}{2}$ in. deep with a $\frac{3}{8}$-in. Jennings' auger-bit. Then bore eight similar equidistant holes around the middle, eight on each side of the middle series, and four around the top and bottom holes, always directing the point of the bit towards the centre. Fig. I shows how to distribute the holes. With a sharp gimlet, bore from hole to hole in all directions about $\frac{1}{4}$ in. below the surface; then cut all ways with a fretsaw or keyhole blade (see Fig. 3) until the interior is disconnected, taking care not to roughen the edges of the holes too much. Now cut downwards (see the thick lines, Fig. 4) from the gimlet holes to the depth of the $\frac{3}{8}$-in. holes with a wood-carving knife having a blade similar to Fig. 5, and remove the splinters, leaving a solid ball enclosed by a thin covering. Then trim the inner ball and all the holes in the outer shell with a riffler resembling Fig. 6. To obtain a hollow perforated ball somewhat larger than the solid one, bore holes in the same positions but right through to the centre, so that opposite holes meet; thus the interior of the ball is gradually hollowed. Use the gimlet and saw as before; then carefully work over the surface and interior of the inner perforated ball with the riffler and the knife passed through the holes. When the two balls are quite independent, remove the saw marks from the inside of the outer ball. The number, size, and shape of the holes can be varied in different specimens. Fig. 2 illustrates one style of finish, but to avoid complications the inner ball is not shown. Scatter numerous small holes (as around the centre) over the ball, giving it the appearance of network. Intermix stars, crescents, etc., and square off some of the holes, or imitate roughly the outline of a leaf. Instead of cutting holes, indent continuous branches with small leaves attached, traversing the surface at every available blank. Application of colour makes the pattern more conspicuous. A number of variously coloured dots differing in size and shape represents a mottled surface. Hollow balls are obtained by boring holes as for the perforated inner ball, and then removing all the interior with the knife and riffler. Use sycamore about $2\frac{1}{2}$ in. in diameter; bore $\frac{3}{8}$-in. holes at the top and bottom, and three series either of four or six holes instead of the series suggested at first.

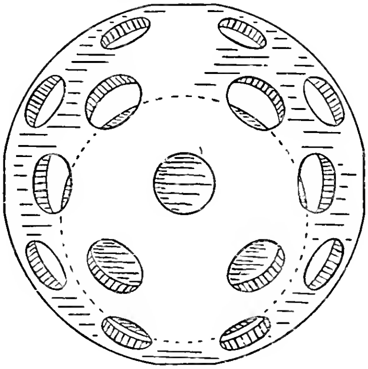


FIG. 1

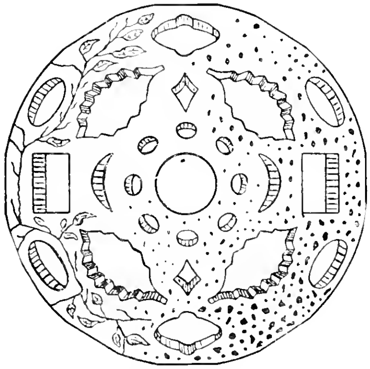


FIG 2

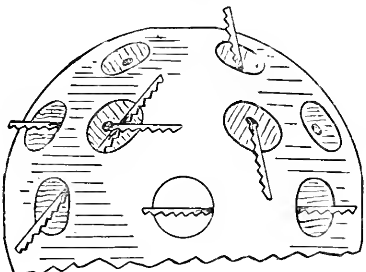


FIG 3

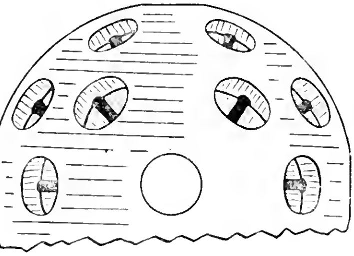


FIG 4

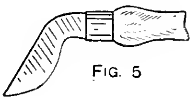


FIG. 5

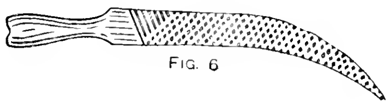


FIG. 6

Cutting a Ball Inside Another.

Re-painting and Re-varnishing a Mail Cart.—If a mail cart is to be re-varnished only, provided it is in good condition, and is not cracked on the surface, a flatting with pumice powder and water should suffice previous to the varnish being applied; and if a second coat is given, the first coat should stand two or three days to get hard, and be only lightly flatted down to remove any nibs that there may be on the surface. If the cart has to be painted, well glasspaper all over, and give two coats of lead colour, stopping up any holes, etc., between the first and second coats. The ground colour should then be put on, giving two or three coats as required. The first coat should be made to dry fairly sharp, the second coat medium, the third coat being made as a glaze, by adding about half of varnish to some of the colour. This coat will require flatting as previously described, after which the lining out is done and the whole thoroughly washed off and given a full coat of varnish. To make a good job, pale carriage varnish should be used, as oak varnish turns the colour.

Soldering Jewelled Ring.—In order to prevent the bursting of the jewels of a ring whilst the latter is being soldered, cut a juicy potato into halves and make a hollow in both portions, in which the part of the ring having jewels may fit exactly. Wrap the jewelled portion in soft paper, place it in the hollow, and bind up the closed potato with binding wire. Now solder with easy-flowing gold solder, the potato being held in the hand. Another method is to fill a small crucible with wet sand, bury the jewelled portion in the sand, and solder in the usual way.

Window Board for Flower Pots.—Fig. 1 is a section through a window board for flower pots showing how it is fixed with brackets and screws to the sash frame.

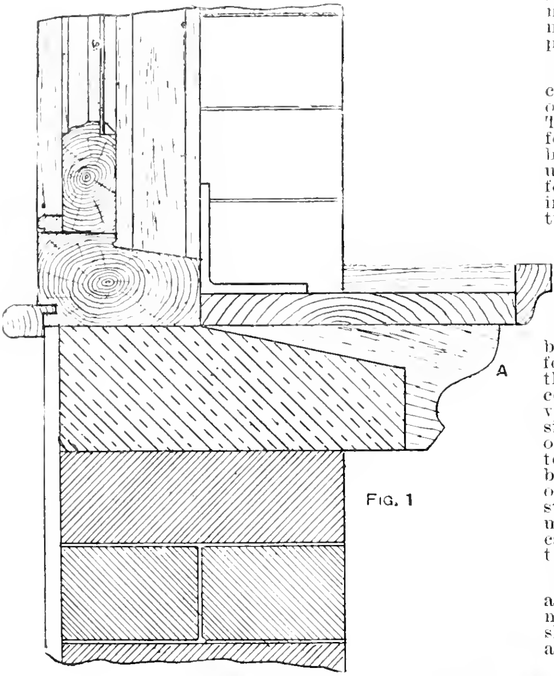


FIG. 1

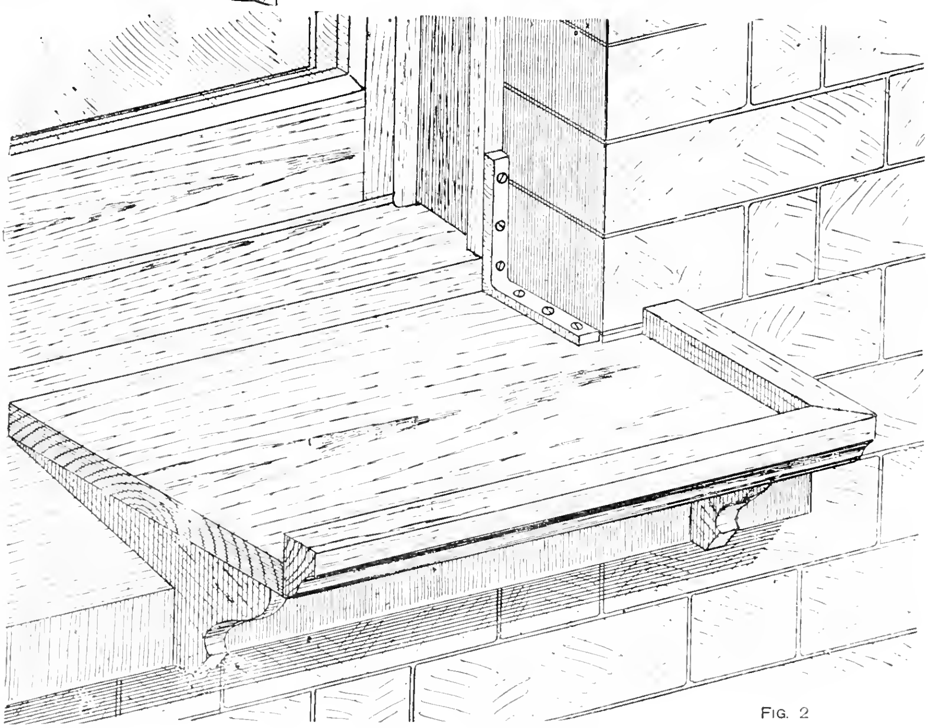


FIG. 2

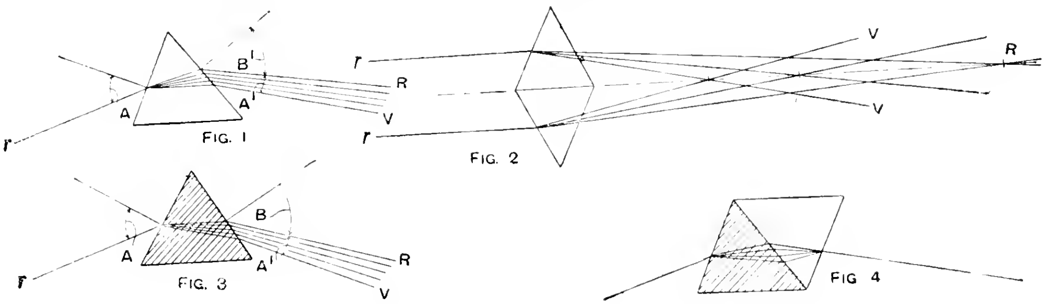
Window Board for Flower Pots.

The board can be kept level with two or three pieces of 1½-in. or 2-in. wood cut wedge-shape to the splay of the sill, and the outer end can be fitted over the sill and the end shaped as shown at A; this will improve the appearance. The board should be about 1 in. thick, and may be of any width from 6 in. to 11 in. It should be cut round to fit the brickwork and just overhang the stone sill, as shown at Fig. 2; the bracket pieces should be nailed to the board underneath. A strip of moulding nailed round the edge, so as to project as shown, will prevent the flower pots slipping off.

Annealing Malleable Iron Castings.—Malleable iron castings are produced by heating castings made of white or mottled charcoal iron, smelted from hematite ores. The patterns should be made with a double allowance for contraction, and in the foundry the "gates" should be wide and thin. The thickness of the metal should be uniform, and no greater than is necessary. When ready for annealing, the castings should be brushed and packed in iron boxes, each casting being surrounded by a mixture of fresh hematite (red iron ore), hematite already used in the annealing process, and iron scale from the rolling-mills. The box is covered up, placed in an annealing oven, and fired at a bright red heat for from three to seven days. After withdrawing from the furnace, the boxes are allowed to cool, and the castings are cleansed from the adhering ore. The castings will now be tough, strong, flexible, and much softer, and may be forged. If the process has not been carried far enough, there will remain a core of unconverted iron. Cast-iron contains a high percentage of carbon, whilst the converting material is rich in oxygen. It is generally considered that the change which takes place is due to the oxidation of the carbon contained in the iron. Bends, tees, crosses, etc., for steam-pipe connections, also small brackets for brake levers on omnibuses, are often made of malleable cast-iron for the sake of lightness and strength. Sometimes flexibility is sought, as in ornamental castings for umbrella stands, etc., which may be cast flat, leaves, tendrils, etc., being afterwards bent and twisted to the desired shape.

Plumber's Glossy Black.—A little brown sugar, or a little stout, added to plumbers' soil or smudge will make it more tenacious, and cause it to dry with a slightly glossy surface. Some plumbers soil their joints, after they are made, with black japan or thinned Brunswick black. But it is doubtful whether the effect is so good as when a "dead" black, such as given by ordinary soil, is used.

Rectilinear and Periscopic Lenses for Photographic Use.—The term periscopic is applied to lenses intended for spectacles, which are uncorrected for colour or non-achromatic. For use in a camera they are, of course, much cheaper than the proper achromatic combination, but will never give a sharp image. The reason for this is as follows. When a ray of light is refracted or bent (as happens when it passes through a prism; see Fig. 1), this ray is split up into its component parts, that is, into rays of different colour. (It is, of course, well known that the impression produced by a ray of white light is the combination of the sensations produced by each of the different coloured rays.) The violet rays are bent most, and the red rays are bent least: that is to say, the violet rays cross each other or come to a focus nearest the lens (see Fig. 2), and the red rays cross or come to a focus at a point farthest from the lens, blue and yellow being focussed at different points between the violet and the red. Now, if two prisms are put base to base a diagrammatic or crude kind of lens is formed; and if the courses of two rays r are traced (see Fig. 2), the explanation given above will be intelligible. Thus the violet rays which crossed at V will have spread out again sufficiently at the point R, at which the red rays are focussed, to form a halo or confused disc around each point of violet light, and the red rays form a similar halo at V. The principal rays used in ordinary vision are nearer the red end of the spectrum or colour scale, whilst the rays that are most active, chemically, are at the violet end of the scale, hence the terms visual and chemical foci. In using a periscopic lens, therefore, it is necessary after focussing to rack in the screen usually about one-sixteenth of the focus. Spectacle lenses may be purchased for threepence each, and if used on suitable subjects will yield very satisfactory results. The defects of these lenses are greatly reduced by using a small stop. An achromatic lens consists of two lenses, one of flint (lead) glass and one of crown (soda) glass, cemented together. It is found that although both lenses may disperse the colours equally, yet they have different refractive indices, or bend the rays to a different extent. In Figs. 1 and 3, although the angles of incidence A and the angles of dispersion A' are equal each to each, the angle B is greater than B'. If, therefore, the prisms be placed in opposite positions, the dispersion of one prism will be neutralised by the dispersion of the other, but the ray will proceed as shown in Fig. 4. In all the diagrams, R indicates red rays, and V violet rays.



Rectilinear and Periscopic Lenses.

Cement Wash.—For a cement wash to go over old cement stucco, place a few handfuls of cement in a bucket, and add water until the cement is of the consistency of thin cream. The wash should be mixed in small quantities as required, and should be kept constantly stirred while being used. The old work must be well cleaned down, and rubbed with a stiff wire or bristle brush to remove all dust. If the cleaning down is properly done, the cement wash should adhere without rubbing off. Try first 1 sq. yd. of surface, and wait until it is dry. If the wash rubs off, a little size may be mixed with it; but this admixture of size is not to be recommended, and should be avoided if possible.

Composition of Water.—In judging the quality of water that is to be used for drinking purposes, it is necessary to take into account the source from which the water is procured, because the surroundings of the gathering ground have great influence upon the composition of the water obtained therefrom. Drinking water is obtained (1) from upland surfaces and collected in reservoirs; (2) from springs; (3) from deep wells; (4) from shallow wells; (5) from rivers and streams; and smaller quantities from other sources. Unpolluted waters from any of the above named sources will vary in composition according to the nature of the soil or rock on which the water is collected, or over which it flows, or through which it percolates; but the figures given in the following tabular statement may be taken as examples of the average composition of water from the five sources of supply referred to above. The figures are compiled from the sixth report of the Rivers Pollution Commission, 1874, and from other sources.

Parts per 100,000.

	1	2		4	5
Total Solids	9·67	28·20	43·78	16·80	20·21
Organic Carbon	·322	·056	·061	·048	·341
Organic Nitrogen	·032	·013	·018	·007	·034
Free Ammonia		·001	·012	0	·001
Nitrogen as Nitrates	·009	·383	·495	·033	·266
Chlorine	1·13	2·49	5·11	2·85	1·9
Hardness	5·4	18·5	25·0	9·3	14·0
Hydrogen	66,655·624	66,633·57	66,617·016	66,647·308	66,642·165
Oxygen	33,327·812	33,316·785	33,308·508	33,323·654	33,321·082

The organic carbon and nitrogen in upland surface water, and in river water of very excellent quality, would not be more than ·250 and ·025 part respectively. Waters highly polluted with sewage contain more than ·3 of organic carbon, ·03 of organic nitrogen, and ·02 of free NH_3; nitrogen as nitrates and nitrites may be very low or very high according to the amount of aeration the water has received, from none to more than ·5; chlorine 5 parts per 100,000. No amount of filtration would render fit for drinking purposes water that is polluted by sewage. In such cases the polluting matter is, to a large extent, held in solution, and cannot therefore be filtered out. A filter deals only with matter held in suspension, and possesses no other protective power. Water that is polluted by matters held in solution can be purified only by chemical action artificially induced and promoted, or by such natural chemical agencies as are supplied by air and sunlight and friendly bacteria.

Stove for Vapour Bath.—The stove for a vapour bath really consists of a little lamp containing methylated spirit, with a saucer above, in which is placed about ½ pt. of water (plain or medicated). For a hot-air bath, the saucer of water is omitted. In either case the stove is placed beneath a chair which has a solid seat, not perforated, and the bather sits on the chair. The stove or lamp can be in any simple form. A shallow tin canister with three or four wick tubes through the lid would do. The wicks should be of loose cotton wicking, and they can be adjusted with a needle or piece of wire; a pinion wheel for the wicks is not needed. Methylated spirit in moderate quantity can be burned without a wick if desired. Make a tin saucer with taper sides, so that the diameter at the top is about 1½ in. and at the bottom 2¼ in.; the depth should be about 1 in. This will probably hold enough spirit to give one bath. It is, however, safest to have a stove with wicks. The saucer for the water may be as wide as possible, say 6 in., and should be of very thin metal so that the water will boil quickly.

Chlorate of Potassium.—Chlorate of potassium ($KClO_3$) may be made thus. Pass chlorine gas through a warm and fairly strong solution of caustic potash or carbonate of potash until the alkali is quite neutralised; boil for a few minutes, and evaporate until a scum forms on the surface, and then set aside to cool. The chlorate crystals which form as the solution cools are collected, washed in cold water and purified, and again dissolved and crystallised. Chlorate of potassium crystallises in four-sided and six-sided pearly scales.

Imitation Granite Flooring.—A very good imitation of granite flooring may be made by using granite chippings small enough to pass through [illegible]-in. mesh, $1\frac{1}{4}$ parts; granite dust to pass through $\frac{1}{8}$-in. mesh, $1\frac{1}{4}$ parts; and Portland cement, 1 part. This flooring may be laid $1\frac{1}{2}$ in. thick on a bed 5 in. thick composed of 5 or 6 parts of broken stone to 1 part of cement.

Hipped End of a King-post Truss.—Fig. 1 shows part plan of trusses, ridge, and hips of a king-post roof. Fig. 2 shows the tusk tenon joint between the tie beams, with necessary straps and bolts; also the connection of king posts and straps and bolts at head and at C. Fig. 3 is part elevation of main truss, showing king post and section of tie beam of half truss. Fig. 4 is an isometric view of the lower ends of king posts and portions of tie beam.

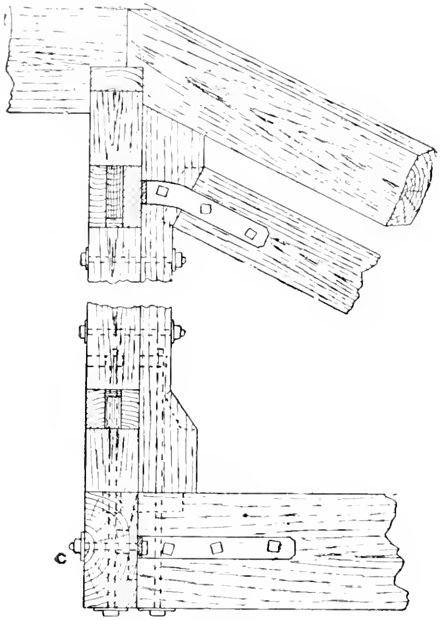


Fig. 2

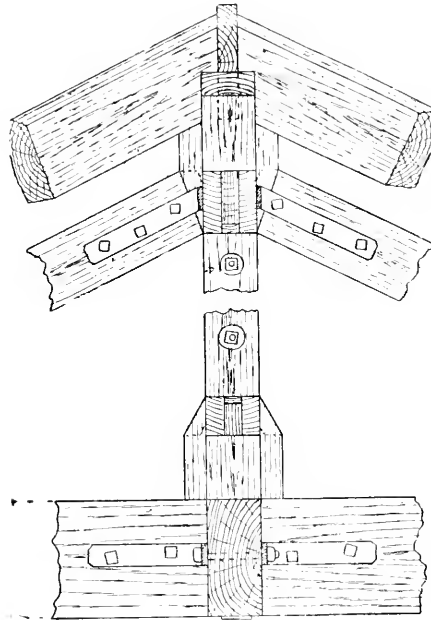


Fig. 3

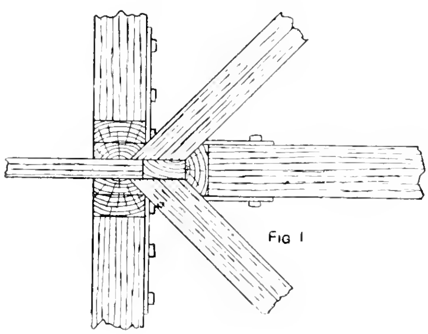


Fig. 1

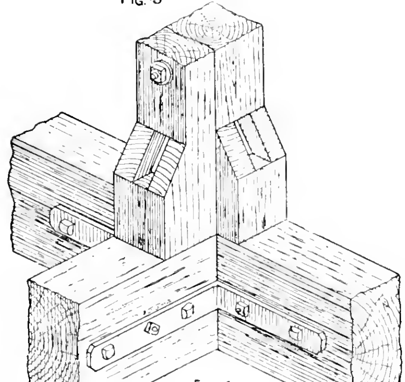


Fig. 4

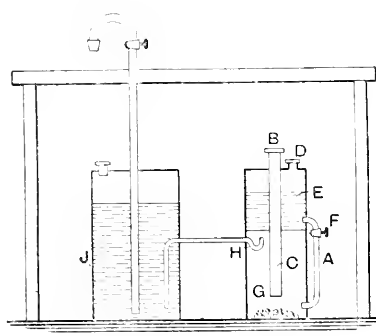
Hipped End of a King-post Truss.

The Manufacture of Soft Soap.—According to the *Soapmaker and Perfumer*, the chief fat used in the manufacture of either smoothed or grained soft soap is linseed oil, and this, if pure and good, gives a lasting, fine transparent soap, and allows more filling than any other fat. Properly made, linseed-oil soaps stand cold the best of any, and even if they have become somewhat turbid during exceptionally sharp weather, they recover their appearance as soon as it gets warmer. The seed yields from 26 to 30 per cent. of the oil by pressure, and the oil will keep a long time without becoming rancid or deteriorating in any way. Besides linseed oil, cottonseed and earthnut oil are much used in soft soap manufacture, and for the cheapest and most filled kinds, oil sediments full of stearine are often employed. These answer in the summer, but are apt to cause trouble by efflorescing in cold weather. Linseed-oil soft soaps are principally used for household purposes, and are of many varieties. Unfilled natural-grain soft soap is the best, and is prepared from two parts of pale linseed oil and one part of good tallow. If the evaporation is carried on till nearly all the froth has disappeared, the soap will be more durable, and faster graining than if the action is pushed farther. For technical purposes oleine gives better results than linseed oil, and produces more soap, weight for weight, but the oleine must not have undergone decomposition. Distilled oleine is often found to have been partially decomposed in the distillation. For some purposes, too, tallow-oleine grain soap is not soluble enough. In washing fleeces, for instance, the hard grain soap often lodges undissolved in the wool, especially if old soap has been used. This is a waste of soap, and hinders the subsequent dyeing operations. For such use, the soap is best made from oleine alone; or a hard potash soap with plenty of carbonate in it may be used. Good soaps for the purpose can also be got from mixtures of oleine with its own weight of palm oil, but if these soaps are kept too long in stock they lose in solubility. A good recipe for a natural-grain textile soap is oleine, 5 lb.;

cottonseed oil, $1\frac{1}{2}$ lb.; hard fat, 6 lb.; bleached palm oil, $1\frac{1}{2}$ lb.; and raw palm oil, 2 lb. A few pounds of tallow not containing too much stearine can also be worked in, and the hard fat mentioned can be replaced by bleached palm oil. Good Lagos oil gives a fine round grain. Such soaps can be filled easily to some extent, and in winter best with 15° B. potash, in summer with 13° B. potassium chloride. It is most important to attend to the composition of the lye. In using 50 B. potash lye, it should, in the colder season of the year, be mixed with a quarter of its weight of 97 to 98 per cent. carbonate of potash in solution, so as to make a 25 B. lye. As with all natural-grain soaps, these soft soaps must be got as nearly neutral as possible. If this and the evaporation are properly seen to, the soap will dissolve easily and the grain will not be too solid. The washing power of a soap depends upon its solubility and lathering power. As potash soaps containing resin are the most soluble, the latter substance increases the cleansing power. Most soft soaps, too, contain an excess of alkali, especially those filled with meal, and this alkali still further increases the washing capabilities of the soap. Linseed-oil soft soaps are made quite unfilled, or containing a high percentage of filling. To get the soap as transparent and as light in colour as possible, even the palest oil sometimes is bleached, and in summer cottonseed oil is used with it. The bleaching is usually done with a 30° B. potash lye not too caustic. When a strong lye is used, the dark precipitate which contains the colouring matter, and also the product of the saponification of the free fatty acid originally present, can be utilised in manufacturing low-grade soaps. One hundred pounds of linseed oil can be bleached with 6 lb. to 7 lb. of the above lye, the lye being run whilst warm into the oil in a thin stream, and being well crutched into it for half an hour. By crutching is meant the stirring together of the ingredients by means of a perforated piece of wood or iron attached to a pole. If the oil is very pale, 5 lb. of lye will suffice for the bleaching; but in any case bleached oil wants a stronger lye for saponification than unbleached. With the latter the lye should not contain much carbonate, and should not exceed 18° B. in strength. Later, stronger lye is added to prevent the soap getting too thick. For the saponification of 100 lb. of oils, 150 lb. of 25 B. potash lye are used generally. To 100 lb. of oil in a pan, 25 lb. of 20 B. lye and 10 lb. of water are added. To ensure quicker union, about 5 lb. of resin should also be added. Heat all up and crutch repeatedly; when an emulsion is formed, boil it in the pan. Now gradually add the rest of the lye, boiling up after each addition. Finally, evaporate over not too strong a fire. In winter it is better not to use soda lye, but in summer soda to the amount of 30 per cent. of the fat can replace part of the potash. The soda is put in all together, after about one-third of the potash lye is in the pan. The resin is often added at the end, and if the soap is rather alkaline, usually makes it about right. A well-finished soap must be thick in the sample glass, should show a good flower, and be quite clear when cold. When soda is used, less evaporation is needed. Summer soft soaps must not show so much flower as a winter-made soap, and should keep better. There may be rather more carbonate in the lye if the soap is not to be filled, and carbonate of potash can be added. The above process gives a very pale amber soap. For filling, the best substance is 13° B. solution of potassium chloride, which is crutched in when the finished soap has partly cooled. In adjusting or fitting a soft soap, the use of carbonated alkali is essential. All soft soaps boil tough before they are properly adjusted. When right they break off rather short from the spatula. A piece as big as a half-crown should be set at the edges, but should yield liquid soap on pressure with the finger in the middle. Subsequent filling will not do away with the bad results of careless fitting, and in any case the soap will turn rancid if deficient in alkali, and brittle and unsatisfactory if there is too much. The following is a good recipe for a well-filled soap. Linseed oil, 100 lb.; resin, 20 lb.; meal, 52 lb.; potash (15 B.), 58 lb.; potassium chloride (23° B.), 20 lb.; and waterglass, 15 lb. Besides this, the addition of from 56 lb. to 58 lb. of fitting lye of 30 B. will be made necessary by the filling. It is often asserted that more filling is wanted in summer than in winter. This is only correct when soda lye is not used. With filled soaps, excess of lye is to be particularly avoided. If the soap is to be made grain, very fine indigo is ground to the finest possible powder, boiled in weak lye, and added to the pan at the very last, when the soap is just going off the boil. The colour is better and more uniform if the indigo is ground up with its own weight of fuming sulphuric acid, and then left to stand for several days in a warm place. The solution is then stirred up with soda crystals until fairly neutralised. In this way the colour is made very soluble in the soap, and is crutched into it very easily, giving an even-coloured product. About 1 oz. of indigo is used for every 63 lb. of soap. Formerly hemp oil was used always for green soft soaps. This oil resembles linseed in its properties, but has a fine green colour. It gives a good leaf-green soap, but the high price of hemp oil precludes its extensive employment.

Framework for Punch and Judy Show.—For a Punch and Judy show, 2-in. square quartering should be used for making the frame, which should be about 3 ft. square and 9 ft. high. The four uprights should be in 10-ft. lengths, halved in the centre so as to work telescope fashion in clamps, and put together with 3-in. carriage bolts, so that the frame may not only be portable, but will allow of being reduced in height if desired. The side pieces of the framework may have iron angle flanges, one-half of the angle being 6 in. long, and the other half 2 in. long. Screw the longer half 1 in. on to the batten; this will leave a square of 2 in., which goes round the uprights and is fixed to them by a 3-in. carriage bolt. Twelve short lengths will be required for the sides of the framework. Upon the four bottom pieces, about 1 ft. from the ground, boards are placed as a platform for the operator; a shelf about 6 in. wide is also fixed on which the figures are worked. Above the shelf is the proscenium, which is about 2 ft. 6 in. high. Make a green baize covering in two parts, so that the top half may drop over the bottom half.

Aërated Water Machine.—In an aërated water machine, the carbonic acid may be generated in a small cylindrical gas vessel A (see illustration) made of stout sheet copper lined with sheet lead. The charge of bicarbonate of soda may be put in by unscrewing the cap B and dropping the soda down



Aërated Water Machine.

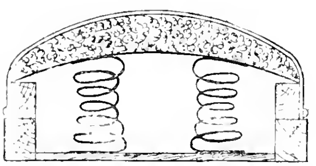
the wide tube C; the cap should then be screwed on again. The diluted sulphuric acid must be poured through the cap D, and remains in the cistern E until required, when the tap F is opened and it is run into the solid charge in G. The carbonic acid passes by the pipe H, which is bent to prevent spurting of the contents into it. It passes into the charging vessel J, also of stout sheet copper, but plated with pure tin. The aërated water is run off by turning the valve on the counter. Sulphuric acid and bicarbonate of soda are used in preference to the seltzogene charges on account of being much cheaper. A gauge may be put on J, if desired, to show how much aërated water has been drawn off.

Renovating Faded Crocodile Leather.—Faded crocodile-leather coverings of furniture are restored to their original dark-green colour in the following way. Remove all grease and dirt from the leather by washing with warm water and soda with a large spoonful of ammonia added. Now take 1 oz. of powdered borax and 2 oz. of bleached shellac, add this to 1 pt. of hot water, and let it stand in a warm place until the gum dissolves. This will take about twenty-four hours. Then strain through a piece of cotton. Now place in the warm solution a packet of olive-green diamond dye; mix thoroughly together, and add a teaspoonful of glycerine. Apply this to the leather with a swab of soft rags or a sponge, rubbing well into the faded portions. When dry, wipe with skim milk.

Preparation of Whiting.—Whiting, Paris white, or Spanish white is mere prepared chalk. To make ordinary whiting, mix ground chalk with water, and allow the sand contained in the chalk to settle in wooden troughs; then transfer the liquid to other vessels where the whiting itself will fall as the sediment. This is dried by the aid of heat. A similar procedure is followed in making Spanish or Paris white, but the chalk is more thoroughly washed and a better and harder quality of chalk—cliff stone—is used.

Renovating Copper and Iron Lamp.—Below are instructions on repolishing and lacquering an iron and copper standard lamp. Take the lamp bracket to pieces, and remove from the copper parts all the old lacquer by boiling in a potash solution; then swill in several changes of clean water, and dry in warm sawdust. The parts must then be polished, and afterwards lacquered either hot or cold, using a very pale lacquer. The iron parts must be smoothed down, and may then be painted with cycle enamel if a polished surface is required. If a dull black finish is desired, after removing thoroughly all grease and dirt, the ironwork may be painted with, or dipped into, a solution consisting of 1 part bismuth chloride, 2 parts mercury bichloride, 1 part copper chloride, 6 parts hydrochloric acid, 5 parts alcohol, and 50 parts water, well stirred together. When dry, place in boiling water, and keep boiling for half an hour. Should the colour not be dark or black enough, repeat the operation. The black is fixed by coating with boiling oil and heating till all oil is driven off.

Putting Spring Seat in Armchair.—Here are instructions on replacing with a spring seat the wooden seat of an armchair. Remove the wooden seat, and fix three battens across, 3 in. wide by $\frac{7}{8}$ in. thick, to act as spring rails. If the seat rails are 2 in. deep, nail on the top all round pieces of stuff, $1\frac{1}{2}$ in. thick, for stuffing rails (see sketch). These rails should form a rebate, as shown. Six 8-in. upholsterers' springs will be required. These are secured to the spring rails with $\frac{5}{8}$-in. staples placed round the bottom coil and driven into the wood. A cover of coarse canvas is put on the top, and tacked fast at the front; then pull the cover down at the back until the springs are compressed by about one-third of their



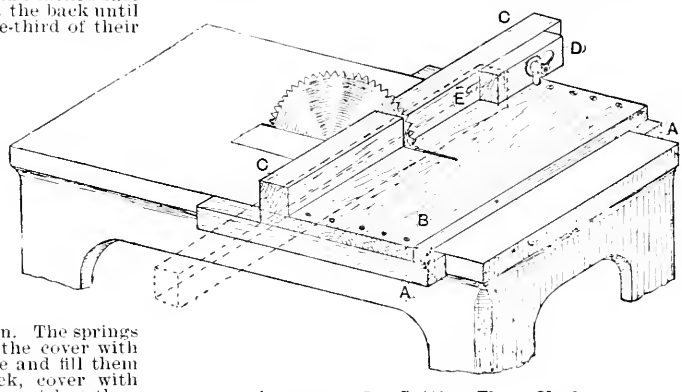
Putting Spring Seat in Armchair.

length, and tack them fast in this position. The springs are securely stitched by the top coil to the cover with strong twine. Loop the edges with twine and fill them hard with well-pulled fibre or rag-flock, cover with scrym, and blind-stitch, and fasten with not less than three rows of stitching. Fill up with flock or hair, well picked on, and cover with sheet wadding, cased in with unbleached calico. Any staining, polishing, etc., should be done before the outer covering is put on. Should the covering be of leather or leather-cloth, finish the edges with leather banding secured with brass or leather-headed studs; if covered with soft material, such as velvet, repps, etc., run a narrow scroll gimp round.

Making School Slates.—Most of the school slates used in Great Britain come from Bangor, in North Wales, and are cut and faced by machinery. To make a single slate, get a Welsh roofing slate, and mark off with chalk to the size wanted. With any sharp point prick a number of holes about 1 in. from the chalk mark, and break off the useless portion. Lay the slate flat on a board and make the chalk mark coincide with the edge of the board. The slate may be cut to size with the edge of a half-round file, a heavy knife, a trowel, or with a joiner's tenon saw. To put a writing face on the slate it is polished in the following way. Select a slate as smooth as possible, fix it on a bench, and rub with a piece of soft sandstone, using sharp sand and water. Finish with a block of wood and finer sand, moving the rubbers with a circular motion. Or, instead, the face of the slate may be smoothed on a grindstone.

Adjusting Surveyor's Level.—In adjusting a surveyor's level, see that the two plates are parallel, with the screw points touching the lower plate. Open the legs to an angle of, say, 30°. Stand between two of the legs and grasp the head of the legs with the left hand. With the right hand place the telescope at right angles to the direction of the leg on your right and move the leg to or from you to bring the bubble central. Then, still grasping the head of the legs with the left hand, with the right hand place the telescope at right angles to its former position—that is, in line with the leg on the right. Move the leg in or out to bring the bubble central in this direction. Then press the legs down firmly and remove the left hand. Now place the telescope over two diagonally opposite screws; turn both at the same time, moving the thumbs inward to bring the bubble to the right, or moving them outward to bring the bubble to the left, and leave it central. Then place the telescope over the other two screws, and bring the bubble central in the same way. The bubble should now remain central in any position of the telescope. Turn the eyepiece clockwise while drawing it in or out until the cross wires can be distinctly seen, then direct the telescope to the staff and focus the object glass by the milled head at the side of the telescope to show the figures clearly. The reading is now taken by the apparent position of the horizontal wire. The two vertical wires enable the surveyor to see when the staff is upright in the direction of the line of vision. The staff is kept in such a position by the skill of the staff-holder, or is slowly waved to or from the surveyor so that he may take the lowest reading at the time the staff will be upright. Two additional horizontal wires may be so placed that they will show, say, 1 ft. on the staff at a distance of 100 ft.; the difference of reading at the upper and lower wires will then be the approximate distance. For example, 3·47 − 2·15 = a distance of 132 ft.

Circular Saw Attachment for Cutting Floor Blocks.—For cutting floor blocks to various lengths the accompanying illustration shows a simple wooden arrangement that can be used with a circular saw bench. A piece of wide board B is fixed with screws to two sliding pieces A, which must fit close to the edges of the table as shown. The fence pieces C should be firmly fixed to B with a few screws. The lengths of the



Apparatus for Cutting Floor Blocks.

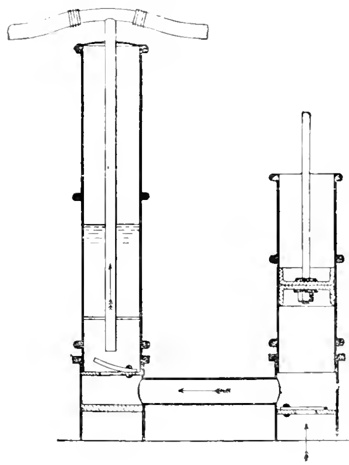
pieces of wood to be sawn can be varied by the gauge block D, which is fastened to C by a bolt and wing nut. It will be seen that a slot is formed in C for the bolt to be moved backwards or forwards, as shown at E. When set, the stuff can be placed against C (as indicated by the dotted lines) and the apparatus pushed forward so that the saw just cuts through the stuff; it can then be drawn back and the timber adjusted for cutting another block.

Transfer Paper for Carbon Process.—Any paper having a grain or texture suitable to the subject under treatment may be used as transfer paper in the carbon process of photography. The paper is coated with a solution of gelatine containing chrome alum, which forms an insoluble surface to which the tissue may be squeezed. The final support (when the picture is first developed on waxed opal and transferred by squeegeeing a sticky surface to it) is coated with soluble gelatine, which, placed in warm water, readily attaches itself to the insoluble tissue, and, on drying, adheres so firmly that the latter will spontaneously leave its waxed support. The paper is coated by drawing it over melted gelatine contained in a trough, the gelatine being kept liquid by an outer water jacket. These transfer papers cannot be well made in small quantities as cheaply as they can be purchased.

Polishing Lead Pencils.—Lead pencil cases are polished by hand with lac solutions as used by French polishers. The rounded strips are 22 in. long, the length of three ordinary pencils. Their handling in large quantities greatly facilitates the polishing operation. The colouring matter may be gamboge for yellow, Bismarck for red, and French black or ebony stain for black. The staining is usually done first, the lac solutions being used clear in order to gain a glaze-like or enamel finish. Staining and polishing the pencils at one operation by dipping would give them a very common appearance.

Waterproofing Underground Water-tank.—To make an old underground tank water-tight from the outside without entirely reconstructing it is a difficult matter. Any solution or composition applied to the inner face of the walls would be forced off by the outside hydraulic pressure. But a lining of asphalt may be put on, and then, if the tank is very deep, an inner wall of bricks set in cement should be built over the asphalt in order to resist the outside pressure of the ground water when the tank is empty. Another remedy that would doubtless be effectual is to excavate the ground for a width of 12 in. to 18 in. outside the walls, and fill the space with puddled clay well consolidated by ramming. If the water comes through the bottom of the tank, lay down a new floor of good Portland cement concrete about 10 in. to 15 in. thick, well consolidated, and with the surface trowelled smooth. If such a floor is laid, the ground water must be kept down by pumping for about thirty-six or forty-eight hours, or until the cement has had time to set properly.

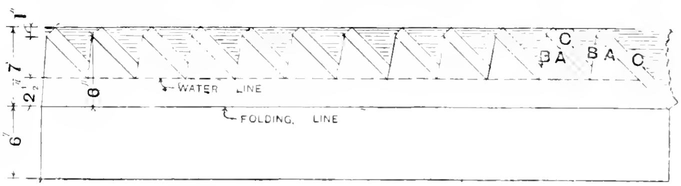
Making a Garden Pump.—A common form of garden pump used for spraying flowers and fruit is shown in the accompanying illustration. It is simply a brass tube with three rings soldered, or rather sweated, on the outside to stiffen the tube. This forms the barrel; a fine thread is usually chased on the bottom to screw into a shorter piece of tube that forms the valve box. To this is soldered a very much smaller piece of tube to connect with the top valve and air vessel. The air vessel consists of two tubes; the outside piece is of the same bore as the barrel, and is strengthened in the same way. A disc-like piece is fastened to the top, through the centre of which a much smaller pipe runs. The space between the two pipes forms the air vessel, a large one. These pumps are made with brass valves, but leather ones are better. The plunger is an ordinary cup leather. Sometimes two pumps are put back to back. Usually two 30-ft. lengths of hose pipe are attached to these pumps.



Making a Garden Pump.

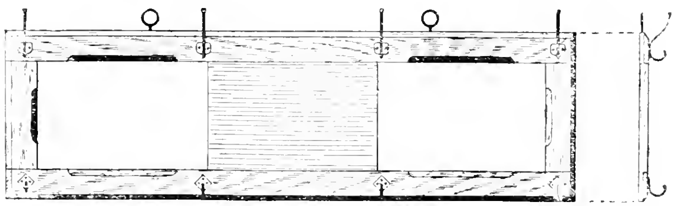
Preparation of Chalk.—Chalk (carbonate of lime) is a soft white rock in a pulverent or only slightly consolidated state, being composed of minute fragments of shells, sponge spicules, etc., as may be seen on examination with a microscope. As far as is known, chalk in large quantities is to be obtained only in the South of England and in the North of France. Precipitated chalk is prepared thus. Add a solution of carbonate of soda to a solution of chloride of calcium until a precipitate ceases to fall; well wash the precipitate with pure water. To make prepared chalk, rub up pure chalk with sufficient water to form a smooth cream; stir into a large quantity of water, allow the coarser particles to settle, and decant the milky fluid; the prepared chalk will fall as a sediment in this, and must then be dried. To prepare camphorated chalk, reduce ¼ lb. of camphor to a fine powder by triturating it in a mortar with a little alcohol; mix thoroughly with 1 lb. of precipitated carbonate of lime (chalk) and 3¾ lb. of powdered orris root, and sift through finest bolting cloth. Another process of preparing camphorated chalk is to mix together 1 oz. of camphor and 15 oz. either of precipitated or prepared chalk; the ingredients must be in the finest powder.

Cutting Out Stepped Flashings for Roofs.—In marking off, cutting out, and fixing lead step flashings proceed as follows. The lead should be cut out 13 in. wide, 6 in. of it to lie on the roof and 7 in. to stand against the wall. The folding line and water line should be marked with chalk, and the lead folded at right angles on the folding line. As roofs vary in their pitch or angle of slope, and as the joints of the brickwork are not always at exactly the same distance apart, the lead, after folding, should be laid in the position it is to occupy, and, with the help of a wooden straightedge, the bottom edge of the joint in each course should be marked with a pointed piece of chalk as far as the water line, as shown at A A in the accompanying illustration. The lead should then be laid on a board on the wall side, and the lines B B marked, one end of this line being 1 in. from the edge of the lead, and the other end cutting the joint line on the water line. Outside the lines A A, mark those shown at C C 1 in. distant. These lines indicate the place of folding for turning into the brickwork. The folding is done with a step turner, which is an iron tool like a double-bladed chipping knife. A temporary tool can be made out of a piece of 1¼-in. hardwood, with one end cut to a bevel, and having a saw-cut equal to the thickness of the lead on one edge. In the illustration, which is drawn for a roof having a slope of 45°, the shaded parts are those which are to be cut away.



Cutting Out Stepped Flashings for Roofs.

Hanging Hall-rack.—The hall-rack described below is intended for the accommodation of clothes, with convenience for hats, clothes brush, etc. A mirror might be added in the centre, and a shelf or box for gloves might be fixed. The centre panel may be round, diamond shape, square, or oblong, and may be of japan lacquer work. The outer rim can be readily removed, or an otherwise plain panel might be made decorative by the aid of transfers, painting, or carving. The size may be such as space will permit; 4 ft. long by 14 in. wide, outside measurements, will be found useful. There can then be four hat hooks and four coat hooks. The rack would look well if made of hard woods, as oak, walnut, or mahogany; it could be made of clean pine, stained light walnut, the chamfer edges being picked out in black. The wood should be at least 2½ in. wide and ¾ in. thick, the corners being halved and glued together—not mitred. A hook planted on each corner will thus give greater security if the screws are sufficiently long. The centre panel, if intended to be merely decorative, should be rebated in, thus bringing it forward; to form the background of a cupboard, box, or shelf this will not be necessary. Hooks may be fixed to this panel if required. The chamfer edges should be cut after the rack is framed up, the outer chamfer being carried right round and the inner ones being stopped at equal distances from the corners and centre panel as is shown in the illustration. Two stout screw-eyes or brass plates, by which to hang the rack, will be sufficient.



Hanging Hall-rack.

Washers for Callipers.—Washers for callipers are best made of mild or spring steel. The hole is drilled, and then the material is made round with a file or emery wheel, put on a mandrel, and turned exactly to size. The ordinary washers, black or bright, would not stand the rivet.

Fitting New Barrel Arbor to Watch.—In fitting a new barrel arbor to a watch, first centre a rough barrel arbor by filing a centre on each end. Affix a screw ferrule to one end and turn the central portion to a diameter equal to one third that of the internal diameter of the barrel. Then turn one pivot to nearly fit the barrel bottom, and a second pivot to fit the plate. Reverse the ferrule and turn the other pivots. Then drill the hole for the mainspring hook. Harden it, and temper to a blue colour. Now place it in the turns again and finish all the pivots to fit their holes, and polish them first with oilstone dust and oil on a flat steel polisher, and finally with crocus and oil on the same polisher.

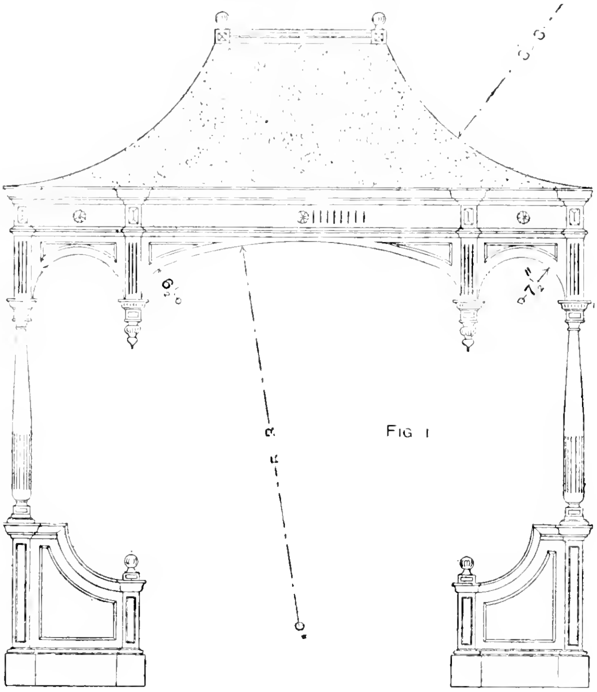


FIG. 1

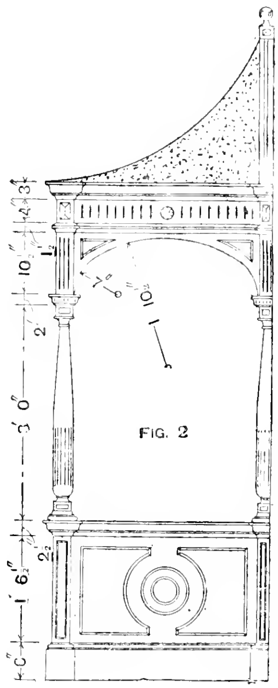


FIG. 2

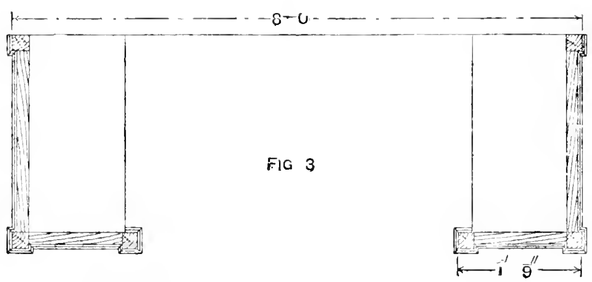


FIG. 3

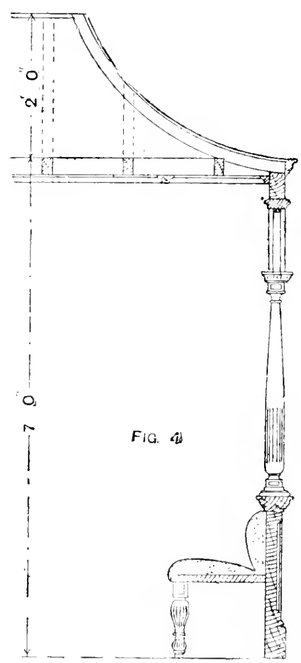


FIG. 4

Ingle Nook with Sanded Roof.

Ingle Nook with Sanded Roof.—The ingle nook with a shingle roof shown in the illustrations is intended for a dining-room. The pillars are 3 in. thick, part square and part turned, and have caps as shown; these pillars support the roof at each corner. Artistic effect will be obtained by introducing the two semi-arches at the side and the elliptical centre arch shown in Fig. 1. These arches are surmounted by a frieze and cornice; the frieze may be fluted or decorated with carton pierre or Lincrusta decoration. The lower framings are $2\frac{1}{4}$ in. thick, flush on the inside. Each end of the lower framing on the outside is ornamented as shown in Fig. 2; and the front, forming the end of the seat, is ramped. These framings have a substantial capping over them. If desired, the capping may be continued horizontally and finished without the ramps, and the pillar at the angle repeated. The roof is formed of concave ribs (see Fig. 4) and horizontal ceiling joists. The ribs are covered with thin pine boarding free from knots and firmly fixed. The pine boarding is then covered with canvas, which is well glued down; and over the canvas is glued a covering of stout brown paper or Willesden paper. The surface of the paper is then covered with a strong solution of glue and litharge and sprinkled over with sharp building sand sifted through a $\frac{3}{16}$-in. mesh sieve. The so-called shingle roof is now complete. Fig. 1 shows a front view of ingle nook, Fig. 2 is the end view, Fig. 3 a sectional plan, and Fig. 4 a section through one end of the ingle nook.

Making a Hand-cart.—The hand-cart shown in Figs. 1 and 2 is very shallow and light in construction. The sizes of the various parts are shown in the illustrations, but space does not permit full instructions on dressing up the material and the method of framing it together. The bottom framing should be of English oak. The bottom-sides A (Fig. 1) are 2½ in. wide by 1¾ in. thick, the ear-bed B (Figs. 1 and 2) is 2¼ in. deep by 1½ in. thick, and the front capping-bar C (Fig. 1) 2 in. wide by 1½ in. deep; two centre summers, 1¾ in. deep by 1½ in. wide, are framed in

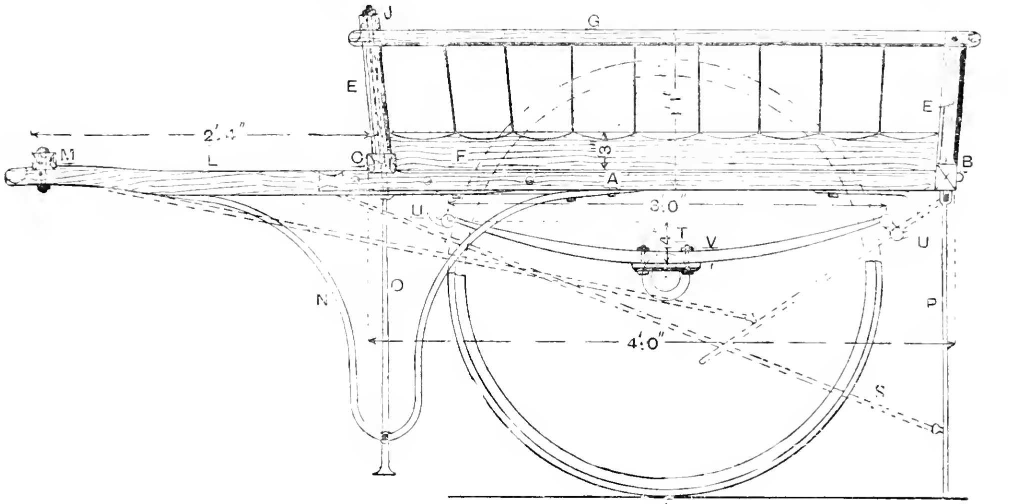


FIG. 1

as shown at D (Fig. 2). The corner pillars E (Figs. 1 and 2) are of English ash, 1½ in. square; the hind one is stump-tenoned into the ear-bed, and when fixed for good has a light strap bolt let in to fix it down. The front corner pillar is stump-tenoned into the capping-bar, and has a bare ⅜-in. bolt running through to keep the whole together. The side boards F (Fig. 1) are 3 in. deep by 1 in. thick, and are let into the pillars level on the inside, hard down on the bottom sides, to which they are fixed by screws. The top rails G (Figs. 1 and 2) are 1¼ in. deep by 1½ in. wide, framed to the pillars as shown; the iron rods H are ¼ in. round, let into the board at the bottom and into the top rail ⅜ in. The front cross rail J (Fig. 1) is of the same size as the side rails, being notched down bare ¼ in. to the side rails, and is fixed by the bolt through the pillar. To strengthen the back part, shore-stays K (Fig. 2), having a flap at the top part to screw on to the pillar and top rail, are fixed. The door is made as shown in Fig. 2, and is hung with 3½-in. wrought-iron butts having brass pins or rivets, which will prevent corrosion. The door may be fastened with a hook and eye on the inside, or a pin and plate on the top rail. The handles L (Fig. 1) are 2 in. deep by 1½ in. wide, bolted on the inside of the bottom side with three $\frac{5}{16}$-in. bolts, projecting at the front end a distance of 2 ft. 4 in., at which point a cross-bar M (Fig. 1) is notched on and bolted down. The legs N (Fig. 1) are made of ½-in. round iron, but the bottom parts are rather stouter; they are fixed underneath the handles at the front part, and beneath the bottom side at the back end. In the centre a light round iron stay O (Fig. 1) is secured by a bolt end through the boss at the lower part of the side leg, the stay being swept up so as to fix underneath the centre of the capping-bar C (Fig. 1). The swinging leg P (Figs. 1 and 2) at the back is also of ½-in. round iron, and is attached to the body by two staples R (Fig. 2) fixed into the bottom of the ear-bed. To the leg is attached a light iron rod S (Fig. 1), which fastens on a hook at the front end, and when not in use the leg is drawn up, as indicated by the dotted lines in Fig. 1. The springs are 3 ft. long to the centre of the eyes, and the compass from the centre of the eyes to over the last plate T (Fig. 1) is 4 in. There are four plates 1¼ in. wide. The scroll irons U (Figs. 1 and 2) are 2½ in. deep at the front part and 3½ in. deep at the back, and are attached to the springs by bare ⅜-in. bolts, with shackles at the back end: when fixed in place, the springs should measure 2 ft. 10 in. outside. The axle is secured on each side by two $\frac{5}{16}$-in. bolts V (Fig. 1), and if cycle-pattern wheels are used there should be a clear space of 3½ in. between the spring bearing and the collar of the axle. The wheels are 3 ft. high. The bottom boards, of ¾-in. red deal, are run crossways of the body, flush with the top of the ear-bed.

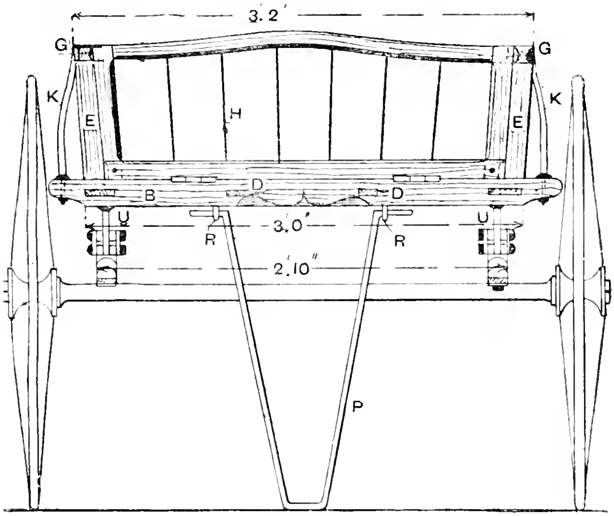


FIG 2

Making a Hand-cart.

Recipes for Paste Blacking.—Recipes for paste blackings are the following. (1) Mix together 8 parts (by weight) of ivory black, 4 parts of treacle, and 1 part of sweet oil, afterwards adding 2 parts of oil of vitriol diluted with 4 parts of water. Moisten to the required consistency with water or stale beer. (2) Superior blacking. Mix together 3 lb. to 4 lb. of lampblack, ½ lb. of animal charcoal, moisten with glycerine, and add 5 lb. of molasses. Fuse 2½ oz. of pure guttapercha in an iron vessel over a fire, and stir in first ½ pt. of olive oil and then 1 oz. of stearin. Add the warm mass to the former mixture, and then add a solution of 5 oz. of gum senegal in 1½ pt. of water, and 1 dr. each of rosemary and lavender oils. (3) Rub together 1 lb. of molasses, 1¼ lb. of ivory black, and 2 oz. of sweet oil, and add a little lemon juice or strong vinegar. (4) Rub together 7 lb. of ivory black, 5¼ lb. of molasses, ½ pt. of common oil, 12 oz. of oil of vitriol, and sufficient water.

Development of Photographic Plates.—The formulæ for developers supplied by the makers of the plates used cannot be improved, and in nearly all cases these developers consist of pyrogallic acid and soda. The pyro-soda developer, as it is called, is admittedly the best all-round developer, and can be used for almost every kind of dry plate that is made. Pyro begins to deteriorate, however, directly it is mixed with water, and cannot therefore be kept in solution for any great length of time so as to be reliable always for occasional use. But if the pyro is used dry—that is, if sufficient for the plates to be developed is weighed out as required—the drawback to its use as an occasional developer is overcome. The right moment at which to stop development can only be learnt by experience. As a general rule, if when viewed by transmitted light the shadows are beginning to veil over, the plate should be removed from the developer. To determine when this veiling begins is a little difficult to a beginner, as the unaltered silver in the plate tends to give a foggy appearance to the image. The growing picture must be carefully watched, and when it contains all the detail that is desired development may be stopped; the final print will show whether development was carried too far or stopped too soon, and it is in this way that knowledge is gained by experience. The time that elapses between the application of the developer and the first appearance of the half tones will in the case of development with a normal developer, if multiplied by 3, give the additional time in which development is complete. Thus, if thirty seconds elapse between the application of the developer and the first appearance of the half tones, development would be complete in ninety seconds more. The appearance of the back is important with any thinly coated plate. When the high lights show at the back of the plate, these lights can become no denser; further development can only allow the half tones to catch up, and the operator must decide how far this is desirable, and act accordingly. A good dark-room lamp with a steady flame is of vital importance, especially to a beginner, and it is sound economy to pay a fairly good price for a lamp. The usual amateur candle lamp makes the proper judging of a plate almost impossible, and much is left to chance.

Grease-proofing Wooden Pill Boxes.—A reliable method of making wooden pill boxes grease-proof is to dip them into moderately strong warm glue size. The dipping should be so arranged that both interiors and exteriors may be coated. Or, if desired, the insides of the boxes may be coated with the glue size, applied with a brush.

Fitting New Roller in Lever Watch.—In fitting a new roller and pin in a lever watch, first procure a soft rough roller and broach out the centre hole to go on the balance-staff to the correct height. Place it on an arbor and in the turns or watch lathe, turn the pipe to the right diameter and length, turn both sides of the roller flat, and reduce its diameter until, when on the balance-staff and in the watch, the lever has just a little shake at each side when the guard pin rests against the roller edge. Then measure the position of the ruby pin-hole so that its pin will come well in the lever notch. Drill it with a small drill and broach it out until a pin fitted in it just enters the lever notch freely. Then file the passing hollow for the guard pin to pass at each beat. Try the action in the watch, and, if correct, harden the roller and temper to a red colour. Polish the roller on the face, and especially on the edge, with crocus and oil on a steel polisher.

Imitating Dove Marble.—For an imitation of dove marble, the ground colour must be a bluish-grey, and must be worked on while it is wet, in the following manner. Provide a little dark blue-grey paint, a little black paint, a little white paint, and a pot containing turpentine. Dip a feather into the turpentine, then into the dark blue-grey, and occasionally into the black. Streak the groundwork with the feather, running always in one direction. Use the white paint in the same way, and put in a few small solid white patches, which should be softened at the edges. When dry, scumble the surface with thin white paint.

Rack for holding Greenstuff Food.—The illustrations show the construction of a rack for holding the greenstuff with which poultry are fed. The wood for the middle and side frames should be about 2 in. by 1¼ in.; the joints should be halved together. The bars may be of ⅜-in. round galvanised iron.

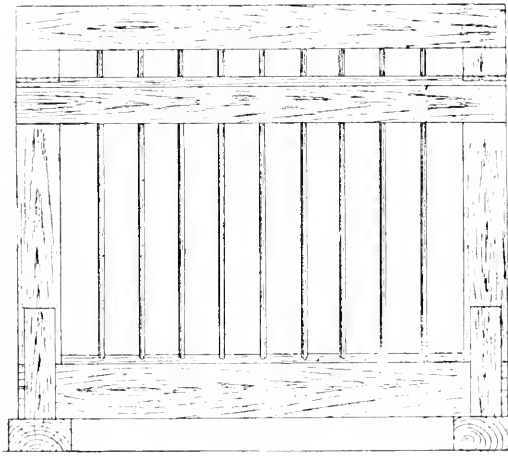


FIG 1

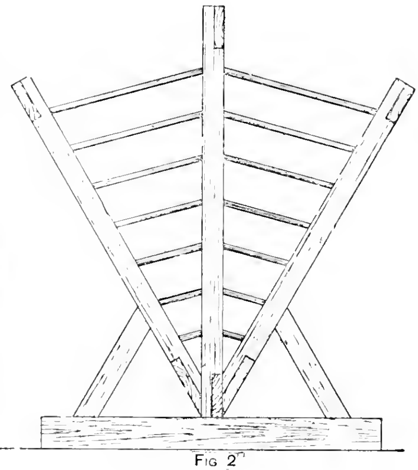


FIG 2

Rack for holding Greenstuff Food.

Oil of Amber.—Amber oil is a product of the dry distillation of amber, and consists, in its crude state, of a mixture of water, succinic acid, and oil of amber. On standing, it separates into three layers, the lowest consisting of water, the next containing the bulk of the succinic acid, while the top layer contains the oil of amber. This oil, when drawn off, is found to be a dirty brown, fluorescent liquid, possessing a nauseating odour. It is insoluble in water, but is soluble in alcohol, ether, benzene, and many other solvents. The oil is scarcely acted upon by dilute mineral acids, but concentrated sulphuric and nitric acids react violently with it. By the action of nitric acid much succinic acid is produced, and an orange-coloured resin possessing a strong odour of musk is produced; this is used as an artificial musk. Reducing agents do not affect amber oil, and treatment with animal charcoal and other decolorising agents does not in the least improve its colour. In distilling oil of amber, first water is obtained, then a yellow oil, followed by a green oil, and lastly a dark green oil. The temperature during distillation ranges between 150 and 360° C. A tarry matter remains behind amounting to about 15 per cent. of the crude oil used. The distillates obtained still possess the repugnant odour of the original oil. By carrying out the distillation, however, in a current of steam, almost odourless distillates are obtained. These distillates can be bleached by adding to them about 8 per cent. of permanganate of potash or bichromate of potash, together with the required quantity of dilute sulphuric acid. The oil is then left to separate from the water, the latter drawn off, the oil completely dehydrated by the addition of common salt or plaster-of-Paris, and then filtered. In the bleaching from 7 to 9 per cent. of the oil is lost.

Removing Weather Stains from White Marble.—Weather discoloured marble may be bleached with a solution of soap lyes and whiting. Mix the soap lyes and whiting to the consistency of paste, and apply a good coating with an old brush. Let the paste remain on the marble for a couple of days, then wash off with clean water—rainwater for preference—repeating the process two or three times until the stains are removed. To make the lyes, obtain, say, 7 lb. of American potash and dissolve in a pailful of rainwater. The lye is of such a caustic nature that it is dangerous to fingers and nails. If, therefore, any of the liquid gets on the hands, they should be at once well washed in water containing a few drops of vinegar or acid.

Constructing a Cesspool.—Assuming that the quantity of sewage amounts to 300 gal. per day, and that the cesspool could be emptied every three months, a cesspool should have a capacity of about 4,300 cub. ft. If the pool is 10 ft. deep (measured below the inlet drain), it must be not less than 20¾ ft. square, or of an equivalent area if of any other shape. If the pool is to be emptied every six weeks, half the area given above would suffice. The method of construction is as follows. After marking out and excavating to the required dimensions (the pool being either circular, or rectangular with internal buttress walls), the bottom of the pool should be covered with concrete from 6 in. to 12 in. thick, according to the nature of the soil. The walls should be of brick in cement; and if the pool is rectangular in shape, the bays between the buttresses should be curved outwards to resist the thrust of the earth when the cesspool is empty. If the surrounding soil holds much water, the walls of the pool should be puddled outside with clay, otherwise the cesspool will quickly fill up with water that has drained in from the adjacent land. Brick arches, or H-iron joists with concrete filling, can be used for covering the cesspool, a manhole with cover being constructed to afford access to the pool when required. The best way to empty a cesspool is to raise the sewage into a night-soil cart by means of a chain pump. Cesspools are generally unsatisfactory, and are being superseded by systems of bacterial tanks which dispose of the sewage daily without offence.

Zinc.—Zinc (Zn), a bluish-white and highly crystalline metal, is very malleable when pure, but impure commercial zinc is inclined to be brittle. It melts at 773° F. and has a specific gravity varying from 6·86 in the cast state to 7·21 when rolled or forged. Cast zinc is named spelter, only the rolled metal being known as zinc, as a rule. Zinc oxidises at a red heat, but the rolled metal will form a film of grey suboxide at an ordinary temperature if in a damp situation. Zinc is hardened by rolling, and is annealed at a low heat to make it malleable again. Pure zinc is dissolved by nitric acid and alkalies, but not by hydrochloric or sulphuric acid, although the commercial metal is readily dissolved by either of these latter acids. Zinc is much used as a pure metal, and also in alloys. "Galvanised iron" is sheet-steel coated with zinc. The chief ores of zinc are zincite (red oxide of zinc), a white ore when pure, but usually of a reddish colour owing to the presence of oxide of manganese; blende or "black jack," a sulphide which is a black or yellowish-black ore, with sometimes a reddish tinge imparted by galena; calamine, a carbonate; and electric calamine, a silicate. Zinc is very volatile, and thus has to be extracted from its ores by distillation. In reducing blende, it is first oxidised and then treated with carbon and carbonic oxide, or by hydrogen and hydrocarbons. The powdered blende is roasted in a reverberatory furnace until most of the sulphur has disappeared, and the zinc oxide remaining is heated in fire-clay retorts to a temperature of about 1832° F. (1000° C.), and the vapours are condensed.

Making Divan Settee.—Fig. 1 is a front view of half the framework, Fig. 2 is a side view, and Fig. 3 a section of a divan settee showing the position of the springs, etc. The extra length of the settee will necessitate it being supported in the centre with a pair of additional legs. The three back legs are 3 ft. long by 1½ in. thick, with a sweep of 3 in. The three stump feet are turned from 3-in. by 6-in. blocks. The seat rails and back rails are 2 in. square, and the stuffing rails 2½ in. by 1 in. Mortise joints can be used in preference to dowels. For the seat, eighteen 8-in. springs, placed in six rows of three each, will be required, and for the back, twelve 6-in. springs put in zigzag form; if spring bolster arms are placed on, put three 4-in. springs to each arm. For the covering will be required four 22-in. bags, two for the seat and two for the back; and two 18-in. bags for the bolster arms. About 6 yd. of Utrecht velvet will be wanted for the surrounds and 4 yd. of 6-in. fringe for the trimming. The settee will fill a recess 7 ft. by 2 ft. 3 in.

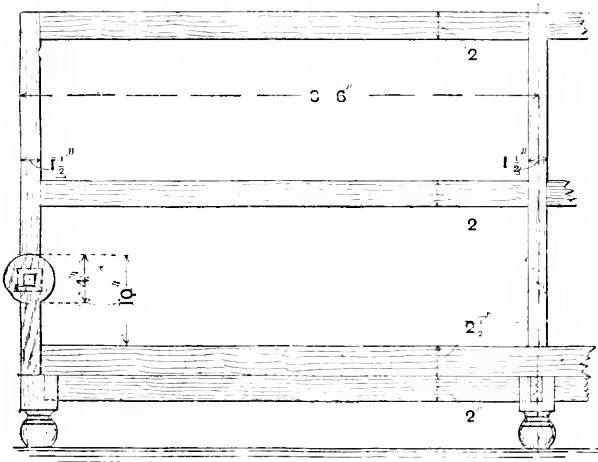


FIG. 1

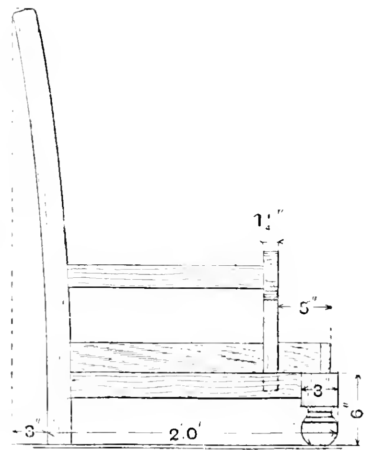


FIG. 2

Making Divan Settee.

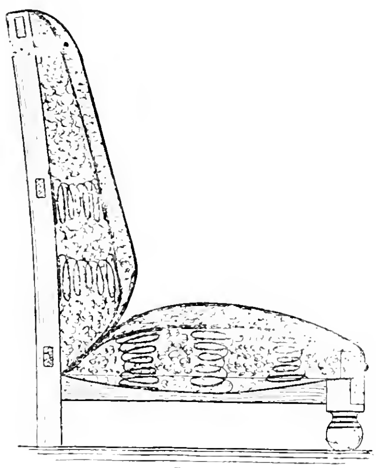


FIG. 3

Making Incense.—To obtain a slow-burning incense, add cedar-wood powder or wood charcoal and nitre to gum olibanum, gum benzoin, and gum galbanum; the gums in this mixture are volatilised without burning, and disseminate their odour through the air. The following is given as a recipe for incense. Sandal-wood powder, 1 lb.; cascarilla bark powder, ½ lb.; benzoin powder, ½ lb.; myrrh, 2 oz.; nitre, 2 oz.; and grain musk, ¼ dr. A portion of the benzoin might be replaced by olibanum and galbanum, but this will not alter the odour very much. Storax can be added to such a mixture, and would be absorbed by the sandal-wood powder; it may also be absorbed in charcoal.

Connecting Musical Box to Striking Clock.—Properly to arrange a musical box to work in connection with a striking clock to play one tune at each hour, a warning and letting-off mechanism, similar to that in the train of a striking clock, must be added to the musical-box train. But possibly a quick rebounding blow upon the starting lever is sufficient to start the tune. If so, the clock could be arranged to lift a spring hammer as each hour approached, and to let it fall at the hour, thus striking the musical-box starting lever. The hammer should be arranged so as to be just free of the starting lever when at rest. Its spring allows it to hit the lever in falling.

A Bamboo Camera Stand.—To make a small bamboo stand for supporting a hand camera, prepare a cylindrical block of hard wood like A (Fig. 1), boring it through the centre and making cuts B,

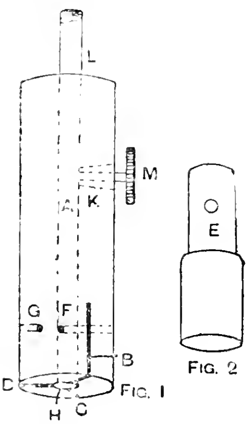


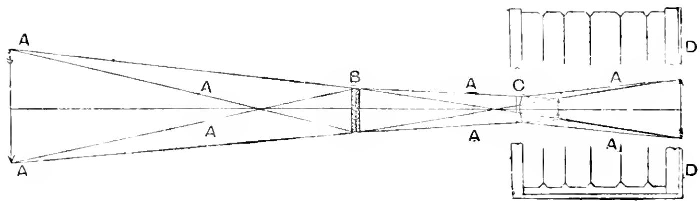
Fig. 1 Fig. 2

Bamboo Camera Stand.

C, and D. Into these fit firmly the hinges or upper parts E of the caps (Fig. 2), passing a pin or rivet through each on which the caps turn (see dotted lines F and G). Through the central hole H pass a brass rod L about 1 ft. long with a screw thread cut on it, to go into the camera base. At K insert a coarse-thread nut to take a thumb-screw M, which bites against L, for fixing it at any height. Fit each of three small bamboo canes with ferrules and insert tightly in the metal caps, and the stand is complete.

Determining Height above Sea Level.—The mode of ascertaining the height above sea level of a hill depends on circumstances. The term "sea level" indicates the mean half-tide level of the sea, and if the distance is short and the height limited, the height of a hill may be most accurately taken by using an ordinary dumpy level and staff. If the distance and height are more extended, a surveyor's compensated aneroid barometer, which is actuated by the pressure of the atmosphere, may be used. A good instrument is divided to show heights varying by 20 ft., but may be read by estimation to 5-ft. intervals. It is adjusted to zero at the lower level and then carried to the top of the hill and read off, but if it is important to ensure accuracy, and the distance to be covered or the time occupied be great, it is advisable to have a second instrument left with an observer at the first station, and the indications recorded every half-hour, so that a correction of the observed heights may be made for the natural fluctuations of atmospheric pressure, the time of each observation being duly entered. When the height of a mountain is to be determined, a mercurial mountain barometer made on Fortin's plan may be used. This construction permits the mercury cistern to be closed entirely secure from leakage of mercury in whatever position the barometer may be placed. The rule for height in using a mercurial barometer is as follows. Read the barometer to the nearest hundredth of an inch; subtract the upper reading from the lower, leaving out the decimal point; and then multiply the difference by 9, which gives the elevation in feet. Thus: Lower station 29·25 in., upper station 28·02 in.; difference, leaving out the decimal point, = 123; this multiplied by 9 = 1,107 ft. elevation. There are small corrections to be made for capillarity, temperature, gravity, etc. The height of a mountain has perhaps been more often determined by observing the boiling point of water than by any other means. It is found that with the barometer at 30 in., which may be taken as mean pressure at sea level, pure water boils at 212° F., and at a lower temperature as the atmospheric pressure decreases. The self-evident reason of this is that the steam can escape more easily from the water when there is less pressure on the surface. There is a simple rule for height of mountain from boiling point which may be seen more clearly from the following: 212° boiling point = datum level; 211° = 511 ft. elevation; 210° = 511 + 513 ft. elevation; and 209° = 511 + 513 + 515 ft. elevation, and so on, increasing the added figures by two each time.

Photographing with Telescope.—A telescope or an opera glass may be used as a telephoto lens (that is, a lens for obtaining larger images of distant objects with less extension of camera) in the following way. Support the telescope with clamps at the necessary angle, the object-glass facing the object. A front fitting the eyepiece must be made to slide into the front grooves of the camera. For the best results it is essential that the focus of the eyepiece should be either one-half or one-fourth the focus of the object-glass, and the distance of separation must always be greater than the difference between their two foci. It may therefore be necessary to substitute a new eyepiece.



Photography with Telescope.

Find the principal focus of the object-glass and, supposing this to be 36 in., then a concave lens of 18 in. or of 9 in. should be fitted at a distance of, say, 19 in. or of 28 in. respectively, giving an equivalent focus of 648 in. or of 324 in. With such a lens the magnification for any given extension of the camera may be found by dividing the distance between the negative lens and the ground glass by the focus of the negative lens and adding 1; thus, $\frac{18}{9} + 1 = 3$. The illustration shows the course of rays A through the object-glass B received by the negative lens C and widened out until they reach the plate D. Thus the magnification (that is, the number of times larger the image will be at D than at C) will depend firstly on the dispersive power of C (that is, the focus), and secondly on the extension of the camera or the distance between C and D. Unless both lenses are corrected for chromatic aberration, sharp definition must not be expected. The equivalent focus shows the focus necessary for a single lens when an image of the same size is required under similar conditions.

Boring Gun-barrels.—Gun barrels are bored with square bits of suitable size; as soon as one bit is used, another is put through the barrel, until the desired diameter is obtained. The barrel is secured on a carriage, the latter being at liberty to traverse the whole length of the bench.

Preparation of Benzene.—Benzene is a hydrocarbon C_6H_6 formed during the dry distillation of organic substances. It is contained in coal tar, which, on being distilled, yields a light oil that is washed with sulphuric acid and with a solution of soda and again carefully distilled; the portion passing over between 80° and 90° C. is separately collected and forms benzene. Benzene is a light volatile liquid, very refractive, and has a peculiar gas-like odour. It readily mixes with oils, etc., but not with water, and is a powerful solvent for fats and india-rubber. It is used largely in the manufacture of aniline dyes, for cloth cleaning, and in rubber working. It is very inflammable, burning with a bright, smoky flame.

Priming for Woodwork.—A priming for outdoor woodwork, which is to be painted white, is made by mixing together white lead, 16 oz.; red lead, 1 oz.; and driers, 1 oz.; thin with half raw oil and turps. No hard and fast rule can be laid down, however, as some white lead will carry double as much thinners as others, according to the quality and age of the lead and whether it is ground stiff or not. For the following coats put less turps in each time—for the first coat, say, one-third turps, for the second coat, one-sixth turps, and for the third coat, no turps. The paint should be of about the consistency of cream.

Wall Rack for Drying Clothes.—Fig. 1 shows a wall rack for use with a gas stove or oven in drying clothes. The rack has a base 2 ft. 6 in. by 8 in. by 1 in., with five rods 3 ft. by 1 in. by ⅝ in. These are mortised in, and glued and wedged. Fig. 2 shows a method of cutting out the rods with economy. As this contrivance may have to support considerable weight, it will be necessary to plug the wall from which it is suspended. Therefore mark off on the wall over the gas stove the positions of the screws, cut the paper in the form of the letter H, and gently raise the two flaps. With a cold chisel, chop out two holes of a rectangular shape about 1½ in. by 1 in., and fit in each hole two taper plugs with the broad ends inside; then, after glueing the centre wedge, drive it in, and when set, cut it off flush to the wall. The paper may now be pasted back in place and the screws inserted, as in Fig. 3. Cut the holes and slots in the base as in Fig. 4, and place the base, etc., in position; the appliance will be perfectly secure but easily removed when not wanted for use. Whenever the gas is lit, the surplus heat ascends and is utilised.

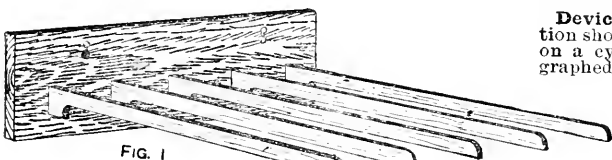


FIG. 1

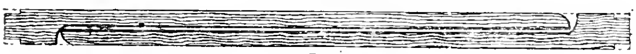


FIG. 2

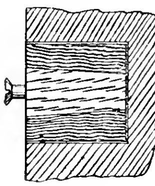


FIG 3

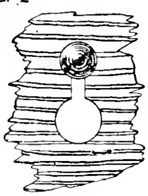
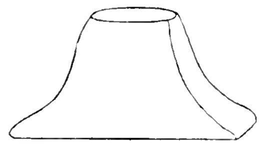


FIG. 4

Wall Rack for Drying Clothes.

Cutting and Polishing Carnelians.—The following instructions on cutting and polishing carnelians, or cornelians, are equally applicable to other stones of a medium degree of hardness, such as agate, amethyst, aquamarine, beryl, bloodstone, Brazilian topaz, carbuncle, cat's-eye, chalcedony, chrysolite, chrysoprase, crystal, elvans, emerald, felspar, flint, fluorspar, garnet, heliotrope, jade, jaspar, lapis lazuli, mina nova, onyx, opal, paste gems, peridot, plasma, porphyry, quartz, sard, sardonyx, serpentine, and topaz. First, the rough carnelian is slit on the slitting mill, which is a thin iron plate revolving at a moderate speed round a vertical spindle, the edge of the slicer being charged with diamond dust and plenty of the lubricant—oil of brick. The carnelian is lightly pressed against the edge of the slicer. The second operation is rough-grinding on a lead mill which resembles the slitting mill, except that the revolving table is of lead. The carnelian is moved to and from the centre of the rapidly revolving lap, which is fed with coarse emery and water, until the marks made by the slitting mill are removed. The coarse emery marks are removed on the lead mill with flour emery, and then, in the case of stones not smaller than ⅓ in. in diameter, the polishing is commenced on a hacked or jarred lead lap, the abrasive material being rottenstone moistened with water; rottenstone would not adhere sufficiently to a smooth polishing-lap. The lap is hacked or jarred by holding an old table-knife blade near the middle between the thumb and finger, the knife-edge resting on the lap at something less than a right angle, so that the knife meets the lap edge foremost when the lap is revolved. The knife is held very slenderly so that it is caused to jump and vibrate and thus make a series of slight grooves or furrows in which the finely powdered rottenstone can lodge. The wheel, afterwards, is revolved in the opposite direction and cross grooves are cut. If the stones have a diameter less than ⅓ in., and if they are rather hard, pewter polishing-laps are used; copper laps are employed for the smallest and the hardest stones, but in all the cases the laps require to be hacked and fed with powdered rottenstone and water. Rounded or convex stones may be worked with emery on a wood mill, then with pumice powder on a list mill, and finally with putty powder on a leather lap. These laps have greater elasticity than the metal ones, and are more suited to the globular forms of stones. To cut facets, a lead wheel with emery, and then a pewter wheel with rottenstone, are employed; for harder stones, a copper lap replaces the pewter one. Small stones, which cannot be held in the fingers, are cemented centrally in the end of a wooden stick. By holding the stick vertically over the lap, the "table" or central facet of the stone is cut; the stick is inclined to certain angles for the eight, twelve, or more facets contiguous to the table. Two, three, or four series of these facets generally are required at different inclinations. The horizontal position of the stick serves to cut the girdle or central band around the exterior edge of the stone. The correct inclinations of the stick are found by placing its upper end into one of several holes in a vertical post fixed alongside the lap.

Device for Photographing Cyclists.—The illustration shows a very simple device for supporting a person on a cycle in an erect position whilst being photographed. The block is painted to match the foreground, and is light on one side and dark on the other. The cyclist places one treadle on the top of the block, and mounts the machine, keeping his foot on the lower treadle on the block, which is behind the machine.



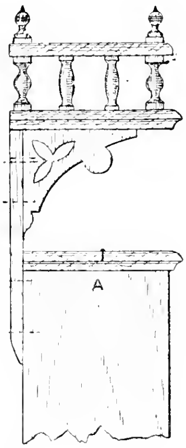
Block for supporting Cycle.

Stripping Silver from Plated Articles.—One method of removing silver from plated articles needs the use of a cold bath. The objects are hung in a large vessel filled with a mixture of 10 parts of sulphuric acid, 66° B., and 10 parts of nitric acid at 40° B. The length of the immersion depends on the thickness of the coat of silver to be dissolved. The liquid when it does not contain water dissolves the silver without sensibly corroding copper and its alloys; therefore avoid introducing wet articles into it, and keep the liquid perfectly covered when not in use. The articles must be placed in the liquid so as not to touch each other, and in a vertical position, so that the silver salt will fall to the bottom. As the strength of the liquid diminishes, add nitric acid. This process is regular and certain, but slow, especially when much silver is to be removed. The second method needs a hot bath. Nearly fill an enamelled cast-iron pan with concentrated sulphuric acid and heat to a temperature of from 300° F. to 400° F. At the moment of using the bath, pinches of dry powdered saltpetre are thrown into it; hold the articles with copper tongs in the liquid and the silver will rapidly dissolve without the copper or its alloy being corroded sensibly. If the process proceeds rather slowly, add saltpetre. All the silver has been dissolved when, after rinsing in water and dipping the articles into the cleaning acid, they do not present black or brown spots, but have the appearance of new metal. These two methods are not suitable for removing the silver from wrought- and cast-iron, zinc, or lead; in these cases it is preferable to employ an electrical method or a mechanical process. Old dissolving liquids become green after use; to recover the silver they are diluted with four or five times their volume of water, and then hydrochloric acid or common salt is added. The precipitation is complete when the settled liquor does not become turbid by a new addition of common salt or hydrochloric acid. The resulting chloride of silver is separated from the liquid either by decanting or by filtering, and is afterwards reduced to the metallic state by one of the usual methods.

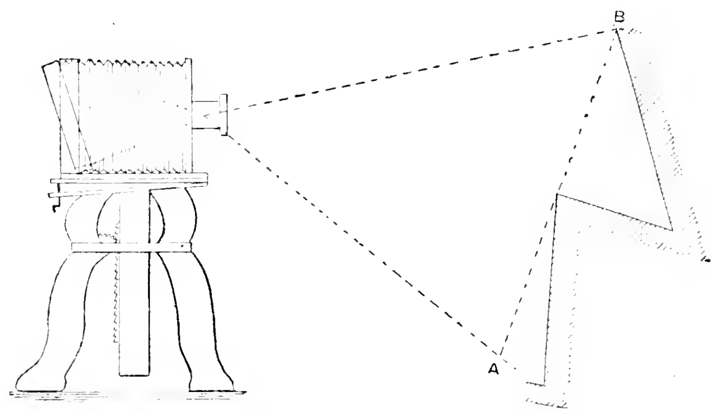
Music Shelf for Piano.—The shelf illustrated here is intended to be fixed on a piano fitted with a half lid: this extends only half-way back, with a long hinge running from end to end. These pianos are usually fitted with a turnover, or overhanging music desk, which, when wanted for use, necessitates the uplifting of the front portion of the lid and consequent upsetting of any articles or music placed thereon. The shelf illustrated will obviate this annoyance, and will at least minimise the jarring noises which generally result from utilising the top of the instrument for the display of ornaments, etc.; it will, moreover, tend to do away with that loss or heaviness of tone often due to the storage of articles on the top of the piano. The shelf should be the same size as the top A, with a moulded edge corresponding to that on the lid; ¾ in. or 1 in. is the usual thickness. It may be fixed about 9 in. above the top by cast-iron or wood brackets as shown in the illustration, or by the use of ornamental shelf brackets such as can be obtained at most ironmongers'. A top-heavy appearance must be avoided, and a spindle gallery, 2 in. high, will add to the effectiveness; instead, fretwork panels might be used. Whether the piano is furnished with a canvas or gauze backing, it should be an easy matter to locate the bracings, which may consist of five or seven uprights forming the framework. The two strips to support the shelf brackets should be securely screwed to those that are 9 in. from the sides, a

mixture boiled gently until reduced to about 3 pt. Strain off the liquid, add 1 lb. of brown sugar and 5 pt. of water, and when it is sufficiently cooled, stir in a cupful of yeast. After fermenting for twelve hours, the beer may be again strained and run into stoneware jars, the corks of which should be tied down. The beer will be ready in two or three days. Herb beer may be kept on draught by storing it in a stoneware jar having a tap at the side. Bottles containing fermented drinks should be kept in a warm place for the first two or three days, and afterwards removed to a cool place to prevent the fermentation proceeding too rapidly. If a cold drink is required, the bottles may be placed in a box and packed with ice and sawdust shortly before being used; or they may be put into a shallow dish of water and wrapped round with a piece of damp muslin kept constantly wet and cool by contact with the water. The evaporation of the water from the muslin causes a considerable fall of temperature. "Still" drinks, that is, those having but little effervescence, such as lemonade and lime juice, may be cooled in a similar way.

Swing Back Camera in Portraiture.—The purpose for which the swing back is employed in portraiture is just the opposite to that for which it is used in architectural work. In the former it is used to accommodate the focus to a figure that does not present a plane surface to the camera. The result is a certain amount of distortion in the figure, but the defect is scarcely apparent unless overdone, and is compensated for by shortening the time of exposure and



Music Shelf for Piano.



Use of Swing Back in Portraiture.

strip of woollen cloth being placed between the iron and the wood to prevent jarring should the screws work loose. To apply this shelf to a piano fitted with a whole lid, a modified system of fixing will be required. The strips at the back to support the shelf brackets must be hollowed out if of wood, or bent if of iron, to allow the lid to open easily when required for tuning purposes, etc. The ironwork should be enamelled to accord with the wood.

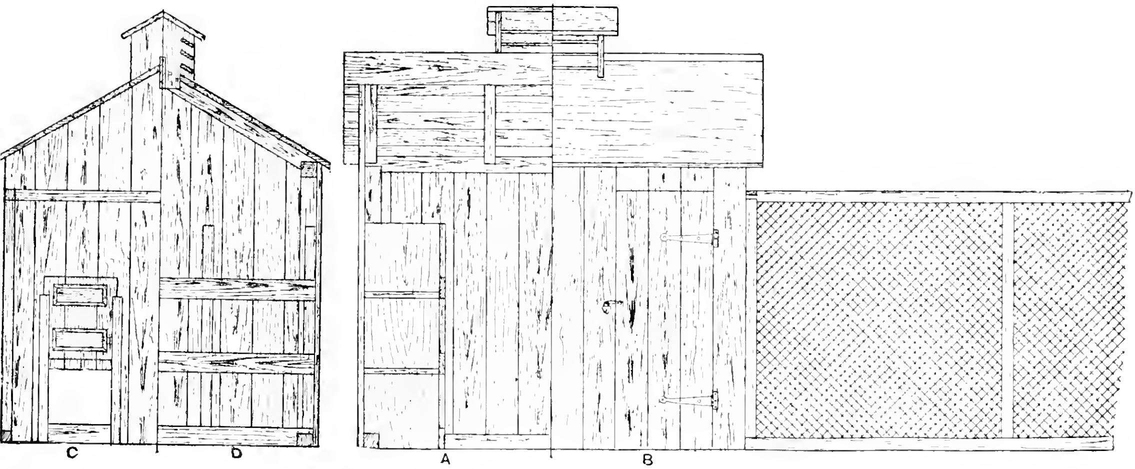
Ginger and Herb Beers.—Ginger beer may be made in either of the following ways. (1) Boil 2 oz. of bruised (not powdered) ginger with 2 gal. of water for half an hour, add 2 lb. of white sugar and 1 oz. of lemon juice, or one sliced lemon, and strain the liquid, which may be allowed to remain in an open bowl for four days and should then be bottled, the corks being wired in. Place the bottles on their side and leave the beer to ferment. It will be brisk in about three weeks. (2) Over 1 lb. of lump sugar, 1 oz. of ginger, ¼ oz. of cream of tartar, and two or three sliced lemons, contained in a large bowl, pour 1 gal. of boiling water, and when cold, stir in a teacupful of brewers' yeast, and cover the bowl with a cloth. Allow the fermentation to go on for twelve or fourteen hours, strain off the yeast, and again strain, this time through two or three thicknesses of fine muslin; bottle it, and wire down the corks. The ginger beer is ready in two or three days. Herb beers are made from herbs possessing medicinal properties; among these are dandelion, nettle, and sarsaparilla, which may be used alone, mixed, or with other herbs; porter, Spanish juice, or liquorice may be added to give the dark colour. The herb may be extracted by filling a large pan either with freshly gathered dandelion or nettle plants, or with the dried sarsaparilla; in place of the latter 1 oz. or 2 oz. of sarsaparilla extract may be used; 5 pt. of water should then be poured over the herbs and the

improved definition. Cameras for portraiture and for architectural work should have swing backs capable of an outward and an inward swing. For this reason the reversing frame must swing from the centre, or the side stays must be specially constructed to lift the travelling frame out of the way of the base. Most field cameras are made to swing forward only. When photographing a sitting figure (represented by the hatched lines in the illustration), it will be seen that the knees are much nearer the camera than the head; therefore, either a much smaller stop must be used, thus greatly increasing the time of exposure, or the swing back of the camera must be altered as shown in the illustration, so that the plate may repeat the plane of focus as indicated by the dotted lines A B.

Cleaning White Leghorn Hats.—To renovate white Leghorn straw hats that have become slightly soiled, wash in hot soap and water (white curd or castile soap for preference), then in clean water, and carefully brush with a stiff nail-brush to remove dust and dirt. Then dip them in a thin size made from parchment cuttings or white gelatine. Shake off the excess and hang up to dry. If the hats have become yellow they will probably need bleaching. This is done by exposing them to the vapour of burning sulphur while they are wet. White Leghorn hats may be cleaned as follows also. Well brush them to remove dust, and wash them with salts of lemon (binoxalate of potash), using a hard nail-brush or tooth-brush. Then rinse the hats in cold water to remove any traces of the acid, and stiffen as described above. The hats, if properly cleaned, will not require bleaching. Should any of the salts of lemon stain the operator's clothes, the stains may be removed by immediately sponging with strong liquor ammonia.

Etching in Gold on Glass.—Below is described how to etch in gold on glass a dull letter with a burnished edge. The glass must first be well cleaned and polished with an old newspaper. A sketch of the letter having been placed on the glass, all those parts of the design that are not to show a dull or matt surface must be carefully covered with asphaltum or embossing black. The glass plate is then surrounded with a raised border composed of wax and Burgundy pitch, and when the protecting asphaltum is dry the plate is flooded with the etching acid. When the glass has been etched to the required depth, the acid is poured off and the plate well washed in cold water and dried and polished. The plate is then sized for gilding, the size being made of a little isinglass boiled in distilled water or filtered rain-water. Apply when cold with a flat camel-hair brush. The gold leaf is then laid on, and when dry is well rubbed with cotton-wool until all the marks are removed. The letter is then backed with red lead ground in quick-drying hard varnish, thinned with benzoline. When the backing is dry, wash off the surplus gold.

Fowls' House with Span Roof.—The accompanying drawings show a fowls' house 6 ft. long, 5 ft. wide, and 6 ft. high to ridge; it has a span roof. The run may be of any length desired. A is a half-longitudinal section showing the nests, etc., B is a half outside elevation, C is a half elevation of the end facing the run, and D is a half cross section showing the nests, etc. The posts and rails should be of about 3-in. by 3-in. stuff, and the rafters of 3-in. by 2-in. stuff. The boarding should be about ¾ in. thick, grooved and tongued; matchlining will be suitable. The roof should be covered with felt. Perches should be fixed where most convenient.

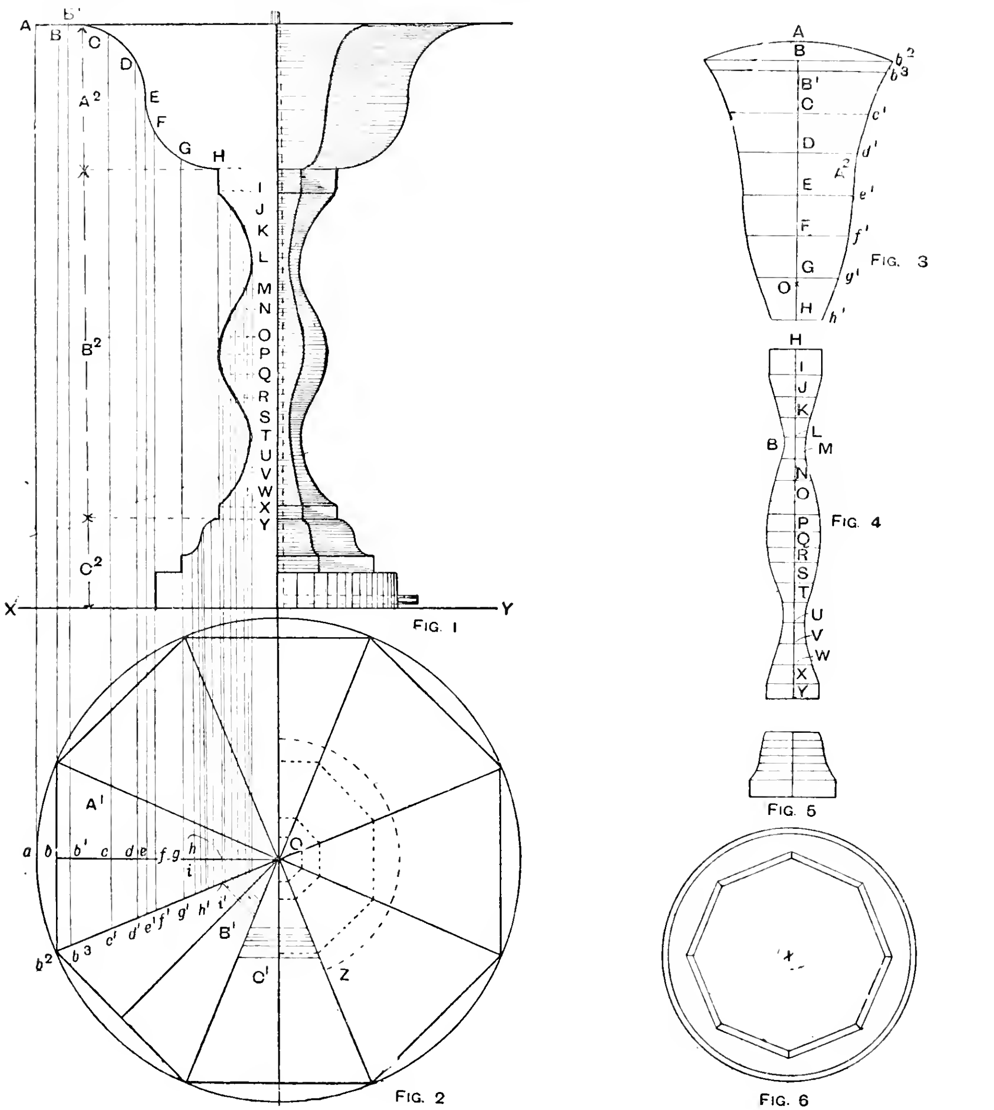


Fowls' House with Span Roof.

Amber.—Amber (known in mineralogy as succinite) is the mineralised or fossil resin of an extinct pine-tree (probably *Pinites succinifer*), and though its colour is a transparent pale yellow usually, often it is reddish or brownish, and sometimes tinged with green, blue, or violet; some varieties of amber are almost opaque. It occurs in beds of lignite and in alluvial soils, but it is found in greatest abundance on the shores of the Baltic, between Konigsberg and Memel, where it is thrown up by the sea; its form may be round irregular lumps, grains, or drops. It is hard, rather brittle, and has a perfectly conchoidal fracture, that is, the surface of the fracture has convex elevations and concave depressions. Amber becomes negatively electric by friction, and the power of electrified amber to attract light bodies was known as early as 600 B.C. Its specific gravity varies from 1·05 to 1·07, sometimes reaching 1·1. It is without taste or smell, but when heated by friction or otherwise emits an agreeable odour; it burns with a clear flame and a pleasant smell, leaving about 1 per cent. of ash; it melts at 536° F. It contains from 3 to 8 per cent. of succinic acid; also, it contains two resins—one melting at 295° F. and soluble in ether, but not in alcohol; and another resin melting at 221° F. and soluble in alcohol and other bodies. When its soluble constituents have been dissolved out by means of ether, amber has a similar composition to camphor—$C_{10}H_{16}O$. On distillation, amber yields an empyreumatic oil which is a mixture of hydrocarbons and succinic acid. Sometimes amber encloses crustacea, centipedes, and insects belonging to species which do not exist now; amber has been found enclosing leaves. The most valuable amber is of an opaque lemon colour, and is known as fat amber. An efficient solvent for amber is not known. Amber may be worked in the lathe, the rough amber first being sawn to shape with a bow saw having a fine wire for the blade, tripoli or emery powder being used with it. Whilst the amber runs in the lathe, it may be heated from beneath by a small lamp or a pan of charcoal, as then it softens and is more easily worked; worked cold, it is liable to chip out. On the same principle, when drilling or tapping amber, warm the tool first, and allow it to remain in the amber whilst the latter hardens again; if the tools are made too hot, the amber will be spoilt. By a simple process of polishing amber, it is smoothed with whetstone and water, and then is rubbed with whiting and water, followed by oil applied on a piece of flannel. When the friction heats and electrifies the amber, lay it aside to cool or it may fly to pieces. Perhaps the more general method of polishing amber is the following. First it is filed to a fairly smooth surface, which is improved by rubbing with Trent sand and water or with scraped Flanders brick and water applied with a flannel. Rottenstone and oil are then rubbed on with a flannel, followed by dry rottenstone applied with the palm of the hand. Amber turned in the lathe is smoothed with glasspaper, and polished with rottenstone and oil. The lapidary polishes amber first on an iron lap with diamond dust and oil of brick; then on a lead lap with coarse emery and water, followed by fine emery and water; then with flour emery and water on a mahogany lap; then on a list mill with pumice powder and water; and finally on a leather lap or piece of buff leather with fine putty powder and water. Sometimes moist putty powder applied by the palm of the hand follows the leather lap. Amber that is to be polished with facets is treated on pewter laps with crocus. Except that the amber is held in the unaided fingers, the process resembles the cutting and polishing of gems. Amber may be tested by (1) warming it slightly; artificial amber will then smell of camphor. (2) Holding a small chip in a flame, when amber melts and burns slowly, whilst most artificial amber burns vigorously. (3) By weighing. The real is not so heavy as the artificial substance. To distinguish amber from fossil copal, heat a particle and hold a piece of moistened lead acetate test paper in the fumes. If it is amber, the paper will be blackened; if copal, the paper will not be discoloured.

Setting Steel Plates.—Steel plates, say of No. 14 gauge, are straightened or set by using a hammer and an iron setter. If, when the sheet is laid flat, there are raised places along its centre, they must be worked down flat by hammering from the edge of the raised part outwards towards the edge of the sheet. If the centre of the sheet rests flat, and the edges are wavy, then the sheet is loose on the edge, and must be hammered from the wavy or loose parts in towards and along the centre of the sheet until the edges are drawn tight and true.

Octagonal Fountain in Sheet Metal.—Fig. 1 shows an elevation of a greenhouse fountain which could be made of copper or zinc. The parts A^2, B^2, and the moulded part of the foot C^2 are of curved sheet metal, which, when mitred at the different edges, will form an octagonal basin, the centre piece and foot resting upon a circular base. The fountain is supplied through the pipe shown projecting at the base, and on the opposite side of the fountain an overflow pipe should be arranged, the top of which projects through the bottom of the part A^2 to a height equal to the depth of water that is to remain in the basin. To work the patterns for forming the fountain, draw to the required size an elevation as shown by Fig. 1, the curved outline on the left-hand side representing the true shape of a section of one face when cut by a vertical plane containing the line a O in plan (Fig. 2). To draw the plan, take half the diameter of the top of the basin as radius, and any point on the centre line, say O (Fig. 2), as centre. Draw the circle shown, then inscribe an octagon within the circle and so arrange it that the side of the octagon containing the points b b^2 is at right angles to the ground line. Bisect this side of the octagon and draw the line of bisection O b. Now divide the curve A H (Fig. 1) into any convenient number of equal parts, and draw projectors from these division points, A, B, B′, etc., to join the mitre line b^2 O (Fig. 2). To work the pattern for the basin, transfer the divisions B to H (Fig. 1) to a straight line, as shown by B, B′, C, D, E, F, G, and H (Fig. 3). Through each of these division points draw lines at right angles to and on both sides of the centre line. Now take the length b b^2 (Fig. 2), and set it off on each side of the centre line (Fig. 3) as B b^2. Also transfer the lengths b^1 b^3, c c^1, d d^1, etc., from the plan (Fig. 2) to the lines with corresponding letters in Fig. 3, and through the points found draw a curve on each side of the pattern, as b^2, b^3, c^1, d^1, etc. Then take the radius O a from the plan (Fig. 2), and with this length mark a point from b^2 at O (Fig. 3); then, using O as centre, draw the top curve A b^2 to complete the basin pattern. The pattern for the centre piece and foot (Fig. 1) is worked in the same way, the divisions from H to Y being the distances to be transferred to the centre line (Fig. 4). The widths to be set off on each side of the centre line are shown in plan on the octagon face B^1 (Fig. 2), those for the foot being shown on the face C^1 (Fig. 2). Fig. 6 is the pattern for the circle forming the top of the cylindrical base. This pattern will be a rectangle, whose length will equal the circumference of the base, and



Octagonal Fountain in Sheet Metal.

whose width will equal the depth of the cylinder. When making the fountain, each section should be bent to the shape shown by Fig. 1, Fig. 3 being made to the shape shown for the basin. Fig 4 is shaped as shown by the part B^2 (Fig. 1), and Fig. 5 is bent to the shape of the moulding for the foot. The sections for the basin are then soldered together, and a small octagon, in which holes are punched in suitable positions for the passage of the pipes, is cut of the same size as the bottom of the basin, and soldered to it. The sections of the centre piece and foot are then soldered together, the foot is joined to the centre piece, and this to the basin.

Aluminium.—Aluminium (symbol Al, melting point varying from 1,050 to 1,292 F., specific gravity 2·6), when of 98·5 per cent. purity, is bright white in colour, somewhat resembling silver, though its appearance depends much on the temperature at which it has been worked. It is capable of taking a high polish. Its melting point may be increased greatly if impurities are present or if it is alloyed with another metal. Aluminium is only slightly elastic: it is, however, fairly malleable and ductile, but these latter properties are impaired by the presence of its two chief impurities, silicate and iron. If of more than 99 per cent. purity, it can be rolled, it is said, into leaves $\frac{1}{40000}$ in. thick, in this respect being inferior only to gold. Aluminium has a tensile strength of 7 tons to the square inch. When pure, it is non-corrosive and resists the oxidising action of the atmosphere, but this advantage has to be partly sacrificed to obtain increased hardness and elasticity by adding small quantities of copper, nickel, or zinc. It dissolves in hydrochloric acid and in most solutions of the alkalies, but it is only slightly affected by dilute sulphuric acid, and not at all by nitric acid. Rolled or forged metal breaks with a fine silky fracture. Aluminium is not found in a metallic state, but when in combination with oxygen, various alkalies, fluorine, silicon, and acids, it is the base of many clays and soils. Common compounds of aluminium are felspar, mica, gneiss, and trachyte, whilst other aluminium compounds, classed as precious stones, are the ruby, sapphire, garnet, turquoise, lazulite, topaz, etc. The ores from which aluminium is commercially reduced are bauxite, cryolite, and corundum. In reducing bauxite, it is mixed with soda ash in a furnace, an aluminate of soda being obtained afterwards, and the insoluble substances are separated by lixiviation. By passing carbonic acid gas through the solution, pure alumina is precipitated, and this is formed with salt and charcoal into balls, which are heated in an earthenware retort through which chlorine gas is passed, the result being that the charcoal combines with the oxygen, and the chlorine with the aluminium; the aluminium chloride sublimes over with the salt (sodium chloride) and forms a double chloride of aluminium and sodium. This double chloride is heated in a reverberatory furnace with suitable fluxes and with metallic sodium; the sodium combines with the chlorine and leaves the aluminium free to fall to the bottom and to be drawn off into ingot moulds. The chemical method of producing aluminium now has been superseded by the cheaper and more satisfactory electrical process. The three best known electrical methods are the Cowles, the Hall, and the Herault, the first-named depending on the heating effect of the electric current and producing aluminium alloys only, whereas by the other two methods aluminium salts are submitted to electrolytic action at a high temperature, pure metal being in these cases produced.

Plumbing Work Aboard a Troopship.—The old-fashioned troopship is now practically abolished, and troops are carried in hired transports, which have to be specially fitted up. The sanitary arrangements for the troops are here briefly described. Great cleanliness is especially necessary among troops who are packed aboard a ship. Every sanitary appliance is thoroughly flushed by a ship's hose several times a day. Fig. 1 shows a section of a latrine, A A indicating water supply in lead pipes, the size of the pipe (from $\frac{3}{4}$ in. to $1\frac{1}{2}$ in.) depending on the size of the latrine and urinal to be supplied. B indicates the latrine, which is covered inside with sheet lead in the same way as a sink or cistern, and is usually about 18 in. wide and 18 in. deep; the length depending on the number of troops to be accommodated. C C indicate lead wastes of 4 in. and 2 in. diameter respectively; D D, taps to regulate the water supply; E, urinal made of sheet lead, same as latrine. Fig. 2 shows a section of a washhouse, F F indicating a tipping chamber made of sheet lead; G G, tin-plate tipping bowls; H H, cam-action taps for water supply; J J, 2-in. waste pipes of lead. Fig. 3 shows a slop shoot. There are usually four of these, two fore and two aft. They are covered with sheet lead, tacked and soldered as shown. They are placed at the side of the ship, so that all slops may be shot overboard. The latrines and washhouses are placed on the upper deck above water level, and the wastes empty into the sea. They are temporary timber structures, the roof being covered with canvas to keep it water-tight.

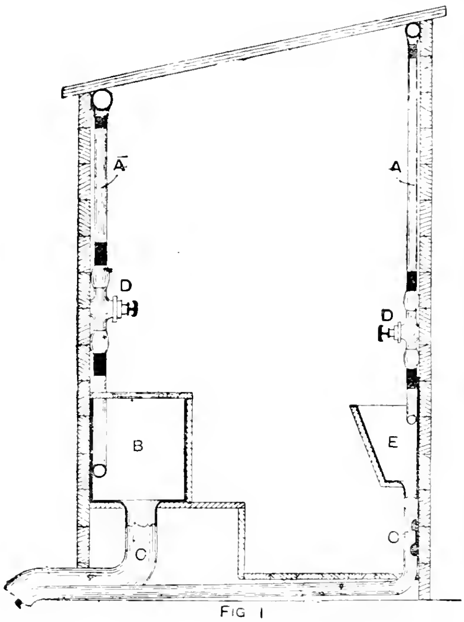


FIG 1

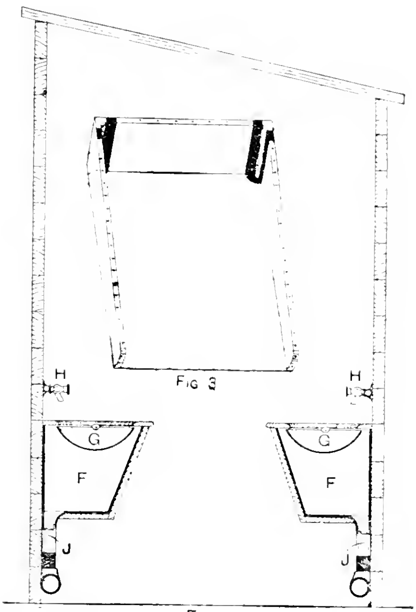
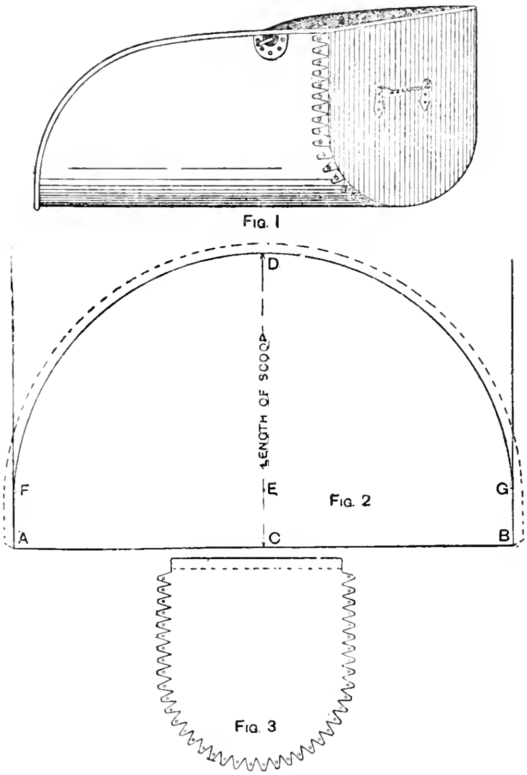


FIG. 2

Plumbing Work Aboard a Troopship.

Cleaning Gilt Bronze Ware.—Gilt bronze ware, if greasy, should be dipped in a hot solution of caustic potash, washed in hot soapsuds, and rinsed in clean water. If not greasy, dip in a mixture of 10 parts of nitric acid, 1 part of aluminium sulphate, and 40 parts of water, and then rinse in clean water.

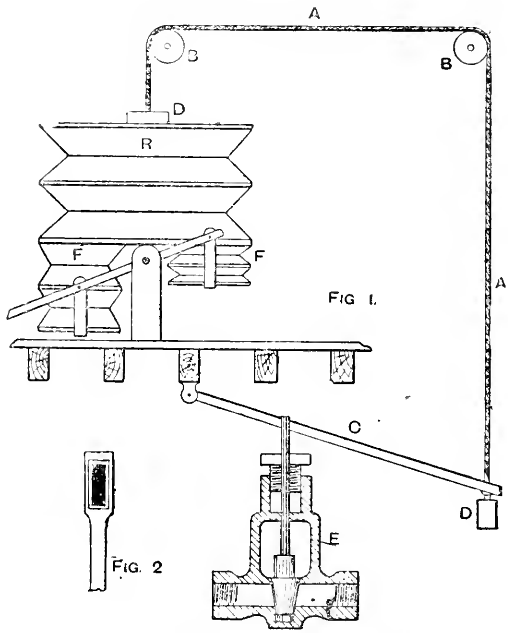
Scoop for a Coal-weighing Machine.—A scoop (Fig. 1) for a coal-weighing machine should be made of No. 19 S.W.G. best charcoal iron. To mark out the pattern of the body (Fig. 2), first square a sheet of iron and set off along the edge a distance A B equal in length to the required measurement around the scoop. At A and B and at C, which is the centre of the line A B, erect perpendiculars; then set off the distance C D equal to the length of the scoop. From D along the line D C measure D E equal in length to A C. With E as centre, and E D as radius, describe a semicircle as F D G. Then A F D G B will be the pattern required. Extra allowance, represented by the dotted line, must be made for wiring. Cut out the pattern, roll it to shape, and set off the wiring edge. Up-end the scoop on a piece of iron and mark round the pattern of the back. The laps for riveting and the wiring edge at the top, shown in Fig. 3, are additional. Punch $\frac{3}{16}$-in. holes in the laps, and bend them at right angles to the back; set off the wiring edge also, but in an opposite direction. Fit the back on, mark the holes, punch them, and then rivet the back in place. The scoop should now be wired, the rod being in one piece and meeting in the centre of the back; otherwise the strength of the scoop will be sensibly decreased. A wrought-iron handle is next riveted to the back as shown in Fig. 1. Two pivots, which should be case-hardened, are riveted to the side of the scoop so as to allow it to rest in position on the machine, and also to enable it to be freely turned for delivery.



Scoop for a Coal-weighing Machine.

Hydrochloric Acid.—The liquid known as hydrochloric or muriatic acid, or spirit of salts, is an aqueous solution of the pure muriatic acid, which is a colourless, invisible gas possessing a pungent odour and an acid taste, and fuming when in contact with the atmosphere. This gas is irrespirable, uninflammable, has a specific gravity of 1·2695, and becomes liquid under a pressure of forty atmospheres. Muriates or hydrochlorates are combinations of this gas with a base. One method of producing the liquid ordinarily known as muriatic acid is to slowly pour 11 fl. oz. of sulphuric acid into 8 fl. oz. of water, and, when cold, add to 12 avoirdupois oz. of dried chloride of sodium contained in a quart flask; through a cork in the neck of the latter passes a glass tube which is connected with a three-necked wash-bottle, furnished with a safety tube, and containing 1 oz. of water. Heat the contents of the flask, conduct the disengaged gases to the wash-bottle, and thence, by means of a glass tube, to a bottle containing 12½ fl. oz. of distilled water; in this bottle the tube dips ½ in. below the surface. Continue the process until 16½ fl. oz. of muriatic acid are obtained. The last bottle must be kept cold during the operation. Commercial hydrochloric acid is a secondary product of the manufacture of carbonate of soda.

Regulator for Reciprocating Water Motor.—When the reciprocating motor described on p. 298 is used for organ blowing, an automatic speed regulator as shown by the accompanying illustrations will be required. In Fig. 1 the feeders are lettered F. The cord A passes over the pulleys B, one end being fastened to the top of the reservoir R, and the other to the lever C which actuates the valve. To keep the cord tight, two weights D are used. E is an ordinary 1-in. full-way valve; the screw spindle must be replaced by a plain rod to work through the stuffing box. The lever passes through an eye (Fig. 2) at the end of the spindle. The length of the lever C should be adjusted so that the



Regulator for Reciprocating Water Motor.

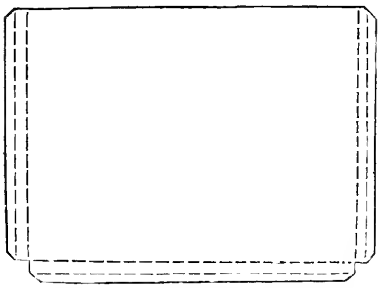
friction of the valve spindle through the stuffing box is overcome, and also so that when the reservoir is full the valve is closed as shown. While the motor is not working the valve will be fully open. On opening the starting valve water will be admitted to the motor, which will now run at full speed. As the reservoir bellows fill, the regulator valve will gradually close, the speed of the motor being thus reduced. On air being withdrawn from the bellows, more water will be admitted, and the speed will increase; a constant air pressure will thus be maintained in the reservoir bellows.

Papering a Ceiling.—The paper for a ceiling is prepared in the same manner as for hanging on a wall. Special attention is, of course, paid to the pasting of the paper, and for obvious reasons it is almost useless to attempt to put a common paper on a ceiling. The paper should be of good quality; and if the paper is a heavy one, it may, as in the case of heavy wallpapers, be temporarily kept in place by drawing pins. In the case of a paper hung on a wall, the paper, until it is dry, is held in place partly as the result of friction, but principally by the adhesiveness of the paste; but when paper is hung on a ceiling, contact is maintained solely by the adhesiveness of the binding medium. It is necessary, therefore, to prepare the ceiling so that the paper may more readily adhere to it by first thoroughly cleaning the ceiling and then coating or sizing it with a solution of glue and whiting. When this is dry the paper may be hung. If the ceiling is at all rough, it should be smoothed with pumice-stone, as paper will not readily adhere to a rough surface.

Making Small Filter.—A small filter for purifying water may be made in this way. Procure a large earthenware flower pot, well clean it, and fix a piece of glass tube in the hole at the bottom. Put in a layer of very small gravel (flint pebbles for preference); upon this place a layer of fine clean sand, and over this a layer of granular animal charcoal about 4 in. deep. Above all place another layer of clean sand. The filter may be supported on a large jug or other suitable receptacle, and the water run in at the top. Plenty of water should first be run through the filter so that the sand and charcoal may settle down properly and the filter become efficient; it will be working at its best when the water falls only in drops.

Soldering Catch on Gun-barrel.—In soldering a catch on a gun barrel it will be necessary to tin the barrels and also the catch, and then to bind the latter to the barrels with strong wire; also bind the barrels for some distance from each side of the catch, making the ribs secure with wedges. To melt the solder, use heaters; these are generally made of copper with iron handles; or iron rods can be used, the ends being made red hot and inserted in the barrels. Cut some small slips of thin solder and place them on each side of the catch, using powdered resin. As soon as the solder melts, remove the heaters and cool the barrels.

Sheaths for Hand Camera with Changing Bag.—The accompanying diagram shows the pattern for a sheath for a hand camera with changing bag arrangement. The sheath should be cut in the zinc and bent on the dotted lines. If fairly thick sheaths are used, and if the sides of the sheaths are bent over, and not



Sheath for Hand Camera with Changing Bag.

merely the top and bottom, as is often done, there should be no fear of scratching the plates.

Preparing Sulphuric Acid.—Sulphuric acid, H_2SO_4, known also as oil of vitriol, is an odourless, dense, oily liquid having a specific gravity of 1·842. Pure sulphuric acid is colourless, but the commercial acid is of a straw to brown colour. It is a typical acid. It occurs but rarely in a free natural state, but combined with certain elements it is common in the animal, vegetable, and mineral kingdoms. A simple method of preparing sulphuric acid on a small scale is to boil sulphur in aqua regia or in nitric acid; the oxidation of the sulphur will produce the sulphuric acid. The two principal commercial methods of preparing the acid are based on discoveries made in the fifteenth century by Valentine. By one process, sulphate of iron (green vitriol, hence the term "oil of vitriol") is distilled in earthenware retorts, the vapour passing into a receiver containing a little ordinary sulphuric acid and forming a brown, fuming, oily liquid having a specific gravity of 1·9; this is the process employed at Nordhausen, Germany, the product being known commercially as Nordhausen acid. The English process may have two forms (1) in which sulphur is used, and (2) in which sulphide of iron (iron pyrites) is used; both of the processes depend on the production of sulphurous acid. Sulphur is ignited and burnt in a conical brickwork oven; just above the sulphur is supported a pot, known as the nitre pot, which is filled with a mixture of sulphuric acid and either soda nitrate or potash nitrate, from 8 lb. to 10 lb. of nitre with from 5 lb. to 6 lb. of acid being allowed for every hundredweight of sulphur. If iron pyrites is used, it is roasted in arched chambers. Under the action of the heated sulphuric acid the nitre decomposes, the nitric acid fumes passing into another chamber along with the sulphurous acid obtained by burning the sulphur. The sulphurous acid abstracts from the nitric acid sufficient oxygen for its conversion into sulphuric acid, the nitric acid becoming nitric oxide, which quickly becomes nitric peroxide by taking oxygen from the air supplied for the combustion of the sulphur. Steam is introduced, and the sulphurous acid constantly being produced takes oxygen from the nitric peroxide and continues the supply of sulphuric acid; thus the cycle of actions and reactions continues until the whole of the sulphur is consumed. The sulphuric acid falls into water, which is drawn off for concentration when it reaches the specific gravity of 1·4. The solution is concentrated first by evaporation in lead pans until the specific gravity is 1·6, and then by boiling in vessels of platinum or flint glass.

Glazing with Putty.—In glazing a window lay the sash on a bench, and with the thumb run along the rebate a bed of soft putty; this is called back puttying. Next lay the piece of glass in its place, and with the second finger gently press along all sides near the rebate to get an even bed. Now get more putty, of a stiffer kind, and run along on all sides. Stand the sash on end, slightly inclined to the vertical, and cut in with the glazing knife (see Fig. 1), allowing the knife to rest on the arris of the wood rebate, inclined at an angle according to the depth of the rebate. Work along each side from the mitre, finishing off in the centre each time. No difficulty will be experienced if the putty is of the proper consistency, but if the putty is too oily it will drag. A little dry whiting in a dusting brush will remove all loose putty after glazing. Fig. 1 shows a proper glazing knife, and Fig. 2 an ordinary stopping knife. The glazing knife should be shorter and firmer than the knife required for ordinary stopping. Only experience can insure proficiency in glazing.

Theatrical Grease Paints.—The base for grease paints is 2 parts of clarified lard or cocoanut fat mixed with 1 part of white wax; or vaseline or paraffin wax may be used. Grease paint is put up in cylinders

FIG. 1

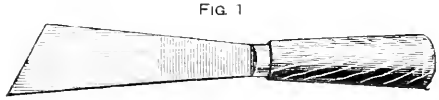
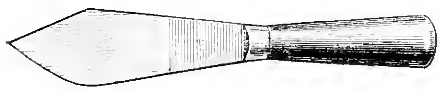


FIG. 2



Glazing Knives.

about 4 in. long and ¾ in. in diameter, and in making a stick of flesh-tinted paint, pigments in the following small quantities will be required. No. 1 tint, deepest: As much vermilion as will cover a sixpence. No. 2 tint, medium: One-third larger quantity of a mixture of equal parts of vermilion and zinc white. No. 3 tint, palest: Same quantity as No. 2 of a mixture of 1 part of vermilion and 2 parts of zinc white. In mixing the colours with the base, warm the latter and rub in the pigments with a palette knife; force into a tube, which is to serve as the mould, and when cold, push out the grease paint with a round piece of wood and wrap in tinfoil. Another way of making flesh-tinted paint is to mix together 3 dr. of vermilion, 2 dr. of tincture of saffron, 5 dr. of powdered orris root, 20 dr. of precipitated chalk, 20 dr. of oxide of zinc, 20 gr. of camphor, 20 minims of oil of peppermint, 1 dr. of bouquet essence, and sufficient almond oil to form a paste. *Brown grease paint*—Melt 6 parts of cacao butter or other base, mix in 1 part of burnt umber, and when nearly cold add 5 drops of oil of neroli. Also see under yellow, below. *Deep red grease paint*—Make into a paste, with sufficient almond oil, 15 dr. each of oxide of zinc, subnitrate of bismuth, and plumbate of alumina; colour with 30 gr. of carmine dissolved in 80 minims of water of ammonia, and perfume with 12 minims of oil of peppermint, 12 gr. of camphor, and 1½ dr. of bouquet essence. *Rose colour grease paint*—Colour the lard and wax base with madder lake. *White grease paint*—Mix together 1 oz. each of oxide of zinc, subnitrate of bismuth, and plumbate of alumina, and 5 dr. or 6 dr. of almond oil. This paste is perfumed by incorporating with 12 gr. of camphor, 12 minims of oil of peppermint, and 1 dr. of bouquet essence. *Yellow grease paint*—Incorporate equal parts of yellow ochre, precipitated chalk, and oxide of zinc, and make into sticks with mutton suet or the base given above; for pale yellow, use more oxide of zinc; for brown paint use burnt umber, and for blue use ultramarine instead of yellow ochre. Grease paints containing bismuth injure the skin.

Using Neat Portland Cement.—When neat Portland cement is used in thin layers that are exposed to the air, it cracks and breaks off. Thus it is unfitted for skimming walls or floors, or for pointing brickwork, and in such cases should be mixed with sand in the proportion of 1 of cement to 1 of sand, or 2 of cement to 1 of sand. Cement may be used neat for jointing drain pipes when the drains are to be filled in quickly, but in most cases the question of expense will prevent neat cement being used for this purpose. The cause of the cracking, and of the brittleness, is attributed to unequal shrinking. Where the cement will not be exposed to air, as in the interior of brickwork, it may be used neat if necessary.

Cleaning Sponges.—To clean sponges, soak them for about half an hour in warm dilute hydrochloric acid (1 part of strong acid to 5 parts of water); remove, rinse in water, and then steep in methylated spirit for a further thirty minutes. The hydrochloric acid decomposes the lime soap which is precipitated in the cells of the sponge, and dissolves the lime, leaving the fatty acids of the soap, which are removed by the spirit.

A Tripod Plate-stand.—The hardwood stand for toast, etc., shown by Fig. 1, is simple, quaint, and useful. However it is placed, three of its legs must rest on the floor whilst the other three are ready to support the plate. Fig. 2, which is one-twelfth full size, is a section through the hub. This is a ball 2 in. in diameter, and through it are bored two ⅜-in. holes, which cross at right angles. Four of the legs or spokes are fixed in these holes, and a third hole (shown in the centre of Fig. 2) is bored at right angles with the two former ones, for the two remaining spokes. Each of these is 8 in. long and ¾ in. in diameter at the greatest widths; they are so shaped as to have some resemblance to racks, this preventing any article set on the stand sliding up either of the spokes, and thus getting tilted aside. A ring of soft metal round the middle of the hub is useful to prevent splitting. The same device might be utilised on a smaller scale for fancy articles; a stand thus arranged might carry a receptacle for odds and ends on a lady's worktable, or a smoker's ash-tray.

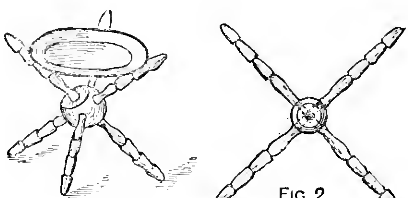
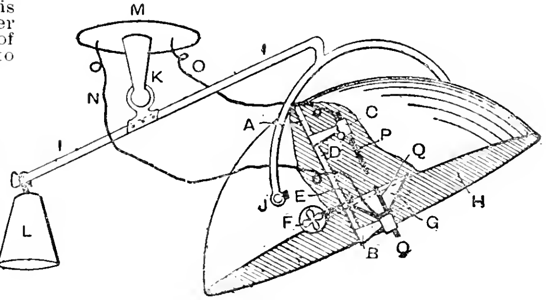


FIG. 1 FIG 2

A Tripod Plate-stand.

The Manufacture of Watch Glasses.—The first watches, the "Eggs of Nuremberg," were oval in shape, and had glasses which had been cut on a stone from a solid block of crystal. Later, when the watches took a round shape, this costly process was again used for the best watches, but for the inferior ones glasses were obtained by cutting, with a red-hot ring, two caps in small spheres of blown glass, the edges being trimmed on a grindstone. As the mechanism of watches lost its bulk, these glasses were found too protuberant, and again glasses cut in the mill from crystal blocks were used; these "cheves" glasses were very expensive. An attempt to reduce the cost was made by blowing small phials whose bases affected the form of the desired glasses. This foundation was separated, and its edges were finished on the millstone. But it was necessary to blow as many phials as glasses, and the price remained high. The modern manufacture of watch glasses differs from the early methods only in the perfection of its tools and better division of the work, but the principle has not altered. A tube has its end dipped in the glass pot and a workman blows a small bulb; this is softened by holding it near the door of the furnace, and, the end of the tube being put into communication with a reservoir of compressed air, a big sphere is blown. This sphere, about 1 yd. in diameter, must be produced without rents, and must be of the requisite thickness. From it are cut convex discs of the size required. Formerly, this was done by marking round a metal template with the end of an earthenware tube at white heat; cold water being thrown over the glass, the sudden contraction of the cold material detached the disc. The modern method is to use a "tournette," which is a compass having a diamond as its marking point. Its use is delicate work. The diamond having traced the circle, the latter is struck on both of its sides with a stick so that it may be detached. Using this disc as a template, the succeeding glasses are obtained very easily. The circles which are cut out touch each other, and leave as waste only the very smallest possible quantity. An able workman will cut 6,000 glasses a day. After the separation, the glasses are in the form of more or less concave discs, following the shape of the sphere from which they were cut. Their edges require to be deepened for the purpose of raising them sufficiently over the surface of the dial to leave a free circulation for the hands. One way of doing this is to place the discs over moulds of fine earth containing a receptacle of the form which the glass is desired to take. These moulds are thrust in an oven, and when the glass is softened by the heat a workman with a plug of paper forces down the glass into the receptacle. After this operation, it is necessary to polish the whole of the glass on a stone; but, to avoid this, a different moulding process may be used. The glass is placed over a mould of the same kind, but of convex form, and of such dimensions that the edges of the disc pass all round it. In softening it in the oven, the sides fall the length of the mould; a workman completes the operation by capping the mould with a wood model. The edges are bevelled on a grindstone and polished on another stone. For costly watches thick glasses are made, and from these the outside convexity is ground off, leaving a flat surface; such glasses are known as "flettage"; from some the central part only of the convexity is removed; these are known as "pointillage."

Electric Arc Lamp for Portraiture.—An automatic feed arc lamp for photographic portraiture is expensive. A clockwork arrangement or an electro-magnet causes the carbons to be drawn together or separated until the correct position is obtained automatically. A hand-feed lamp, however, although demanding more attention than an automatic apparatus, would serve the purpose, and could be fitted up for about one tenth the cost of the automatic lamp. The apparatus merely consists of a bar A (see illustration) to which is fixed a clamp B. Travelling along A is a similar clamp for the carbon C, adjusted by a rack D and ratchet wheel E, worked by the wheel F. An opal reflector G is fixed as shown and receives the rays of light, reflecting them into the larger drum H, which in turn throws the light on the figure. The drum is made to turn somewhat tightly in I at J. A counter-balance L is fixed as shown, and the whole swings from the ceiling at M. By means of the ball socket at K the lamp may be instantly placed in any position. Wires N and O convey the current to the carbons P and Q. Of course, the clamps carrying the carbons must be insulated from the rest of the apparatus. For this purpose the grip of the clamps is generally made in sections with sheets of mica between.



Electric Arc Lamp for Portraiture.

Preparing Calf Skin for Banjo.—To prepare a raw calf skin for a banjo, place the skin in a warm damp spot until sufficient putrefaction has taken place to enable the hair to readily slip; or the skin may be put into limewater with lime in excess. The latter method is quicker, but involves more risk to an amateur. The hair is now scraped off, and the skin placed in the limewater (if this has not been previously done) to remove the grease. The skin is now put on a frame and well stretched in every direction, thoroughly scraped on both sides to remove dirt, loose cells, fat, and flesh, and to reduce the thickness, and then allowed to dry. The above is subject to little modifications. For example, the fleshing knife used by the practical man may be replaced by an ordinary knife and scrubbing brush; the thickness may be reduced by pumice-stone, and the colour improved by dusting on powdered chalk, etc.

Liquid for Dry Shampooing.—A liquid for dry shampooing may be made by dissolving 2 oz. of Castile soap in $1\frac{3}{4}$ pt. of spirit of wine and adding $3\frac{1}{4}$ pt. of water. If desired, the liquid may be scented with a few drops of essence of bergamot. A stronger material may be made by using carbonate of potash (pearlash) in place of soap, but in this case it would be better to wash the head with water afterwards.

Temporary Outdoor Photographic Studio.—Fig. 1 shows a simple form of temporary outdoor photographic studio. It is merely a light structure fitted with a double set of blinds, one blind being of darkish green material fairly opaque, and the other of thin cotton. The thin blinds should be nearly always kept down, but the darker ones are arranged according to the effect desired. The dark blinds should be fixed on spring rollers, which can be purchased, and are inexpensive. The roller consists of a cylinder through which passes a rod, around which is wound some fairly stout wire to form a spiral spring, one end being attached to the rod and the other to the revolving cylinder carrying the blind. The ends of the rod are cut square and fit into square openings in side supports. When working in this studio, a hood or sky shade should be fixed to the lens of the camera as in Fig. 2. The simplest arrangement for a sky shade consists of two rods at A passing through tubes B screwed on each side of the camera; a cloth C may be thrown across the rods. This arrangement serves the purpose of a sky shade and also of a focussing shade.

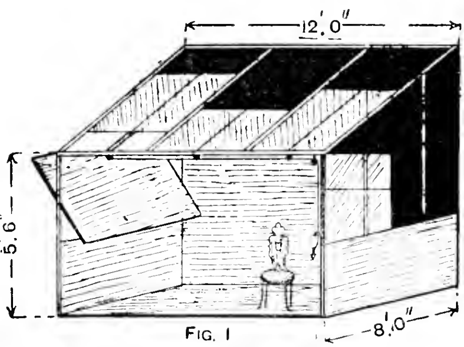


Fig. 1

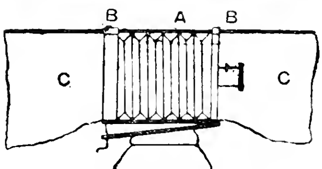
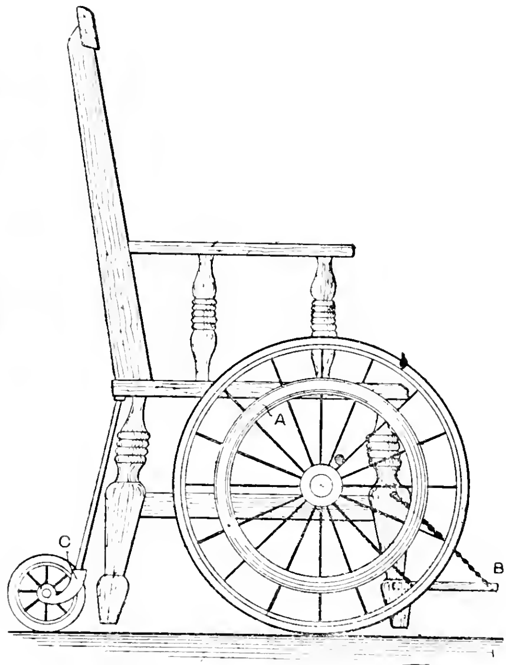


Fig 2

Temporary Outdoor Photographic Studio.

Polishing and Re-silvering Brass Clock Dials.—For polishing brass dials of clocks a lathe is required, although it is not absolutely essential. If only a few dials have to be done, the following hand method, although tedious, will doubtless answer well. The surface of the dial must first be well rubbed down with a pad of leather and very fine emery powder; then go over it again with another leather pad and a mixture of oil and powdered pumice-stone or tripoli. Now prepare a silvering bath made as follows. Dissolve $\frac{1}{4}$ lb. of cyanide of potassium in 16 oz. of distilled or boiled water; in another vessel dissolve $\frac{1}{2}$ oz. of nitrate of silver in 16 oz. of water, and, when dissolved, throw into the vessel a spoonful of common salt, stir well with a stick, and allow to settle. Now dissolve some salt in water, and when the silver solution has settled mix in a few drops of the salt water solution. If there is any cloudiness, salt must be added; stir and allow to settle. If the salt water does not produce cloudiness, the water must be run off and the white deposit or precipitate carefully preserved. Well wash the deposit with boiling water by mixing, allow to settle, and run off. Now to the white deposit add about 1 pt. of clean water, and afterwards, by $\frac{1}{2}$ oz. at a time, the first prepared cyanide solution, till the white powder is dissolved; stir well after each addition of cyanide. Make up the bath to $\frac{1}{2}$ gal. If, on placing the article to be silvered in this solution, a black deposit results, water must be added; if it coats slowly, add white precipitate. Now well warm the clock face, and coat with a layer of beeswax the part that does not need silvering. Immerse the article in the silvering solution till well covered with silver, then take it out, well wash, clean off the wax, and polish the whole surface with jewellers' rouge and oil applied with a very soft cotton pad. An alternative method for silvering is as follows. Dissolve $\frac{1}{4}$ oz. of nitrate of silver in $\frac{1}{4}$ pt. of cold water, and add $\frac{1}{2}$ lb. of cream of tartar with $1\frac{1}{2}$ lb. of common salt ground fine; mix and stir well, adding water till of the consistency of thick paste. Rub this paste on the dial, after rough polishing as at first, for a minute or so. When silvered, clean with a little wet whiting, wash in cold water, and dry. Coat the brass face with thin transparent hard varnish.

Self-propelling Chair for Invalid.—A common windsor armchair can be converted into a merlin chair by adding a pair of bath-chair wheels with a polished wood driving rim (see A in the sketch); the axle is bolted to the cross spindles. The chair is supported at the back by a wrought-iron fork C and an 8-in. wheel; this fork passes through the back spindle (not shown). A footboard is housed into the front leg stumps and is secured by a chain as shown at B.



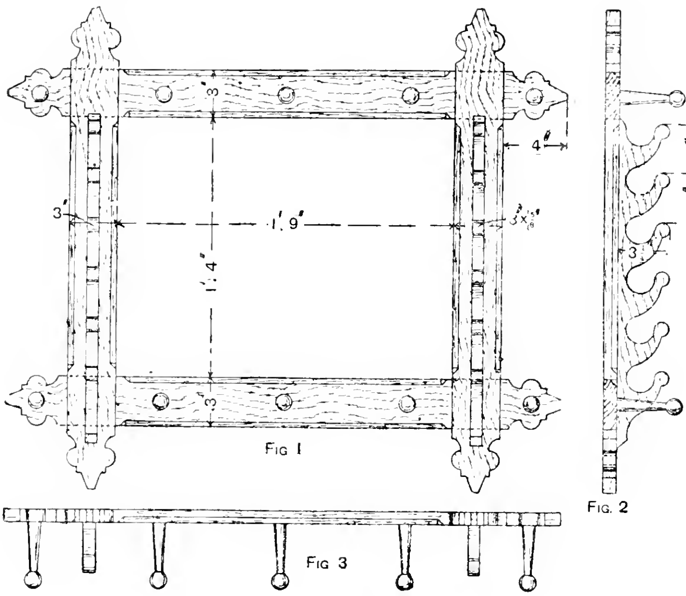
Self-propelling Chair for Invalid.

Renovating Old Leaded Lights.—Old and leaky leaded lights to be renovated should be taken out of the window frames, laid flat on a board, and painted all over with a rather stiff paint of red and white lead and linseed oil, using an old, nearly worn-out paint brush. To force the cementing material well into the lead cames, pressure must be applied to the brush, which should be drawn across the cames. The glass can be cleaned by rubbing with old rags or wisps of hay, and finally polished with clean pieces of rag or hay and wood ashes. The cement may have to be picked out with a pointed piece of wood from the corners of the squares of glass. Finally dust some lampblack over the whole to darken any edges of the cement that may be visible. Both sides of the lights should be treated with the cement.

Frosting Silver.—Polished silver is frosted by a few minutes' immersion in nitric acid diluted with an equal volume of water. A better effect is gained by frequent dipping and withdrawing. On removal from the acid, rinse in water, immerse for a few moments in a strong bath of potassium cyanide, and then rinse in cold clean water. During these processes, handle the silver with wooden tongs or clamps, and do not touch it with the fingers.

Correcting Barrel of English Lever Watch.—One cause of the barrel of a fusee lever watch rubbing on the pillar plate may be that the barrel is too low down, or has too much side shake upon its arbor; or the barrel arbor may have too much endshake inside the barrel. Take out the barrel, hold it square in a pair of sliding tongs, and test the inside endshake. If this is excessive, the barrel cover can be sprung down in its centre by placing it over a hollow in a piece of boxwood and using pressure. A little endshake is necessary. When corrected, place it in the frame and see whether the whole barrel is too low, or if there is so much side play as to allow fouling of the plate. If there is, the holes in the barrel bottom and cover will require bushing. If the barrel requires raising, spring down the bottom in the centre and correct the endshake by springing in the cover a little more.

Stick and Umbrella Rack.—The stick and umbrella rack shown by Fig. 1 is intended for use where there is not room for a hall stand. Prepare two pieces of $\frac{3}{4}$-in. walnut or mahogany 3 ft. 11 in. by 3 in. by $\frac{3}{4}$ in., and two pieces each 2 ft. 6 in. by 3 in. Plane these and gauge them to thickness and width, and halve the corners together, taking care to keep the frame square. Knock it to pieces, shape the corners, etc., clean up carefully, and fill in with



Stick and Umbrella Rack.

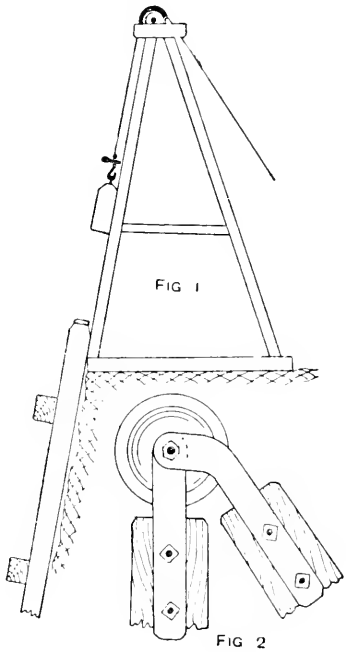
French polish; then glue together. Next prepare two pieces, each 1 ft. 9 in. by $3\frac{1}{4}$ in., for the rack, and shape them as shown by Fig. 2. Polish them and fix them to the frame with three or four screws through the back. Then turn ten hat pegs (Figs. 2 and 3), which may be polished while in the lathe. They can be fixed to the frame by $\frac{1}{2}$-in. dowels, turned on the back ends and glued into centre-bit holes in the top and bottom rails of the frame. Brass hat pegs may be used if preferred. The rack can be finished by polishing.

Gunpowder.—The proportions for the ingredients of gunpowder employed at the end of the nineteenth century are given in the following table:—

	Nitre.	*Sulphur.*	*Charcoal.*
England	75	10	15
France, Prussia, United States	75	12·5	12·5
Russia	73·78	12·63	13·59
Austria	76	12·5	11·5

Gunpowder is an intimate mechanical mixture, not a chemical compound, chemical action taking place when it is ignited. The gaseous products formed by ignition are carbonic acid gas, carbonic oxide, and nitrogen. The explosive force depends upon the amount of gas generated, the heat to which it is raised, and the rapidity with which it is formed. Charcoal supplies the body to be burned, nitrate of potassium the oxygen to support combustion, and sulphur raises the temperature of the gases, and thus increases their expansive force, which, for heavy rifled guns and large charges, is as much as 25 tons to the square inch. All the powder used in the English service is of the same composition, and varies for different purposes only in the size and density of the grains to vary the rate of explosion. By this means, without lessening the velocity given to the projectile, the strain on the gun can be reduced. The larger the gun the greater the density and size of the grains. Thus for 80- and 100-ton guns, prismatic powder of hexagonal shape, from 1 in. to $1\frac{1}{4}$ in. thick, and having a density of 1·75, is used, whereas for rifles and machine guns fine grain is employed, having a density of 1·72.

Driving Piles on a Batter.—The guides of the pile-driving machine must be set to the batter at which it is intended that the piles are to be driven. The easiest way to do this with a machine having upright guides will be either to shorten the back raking shores



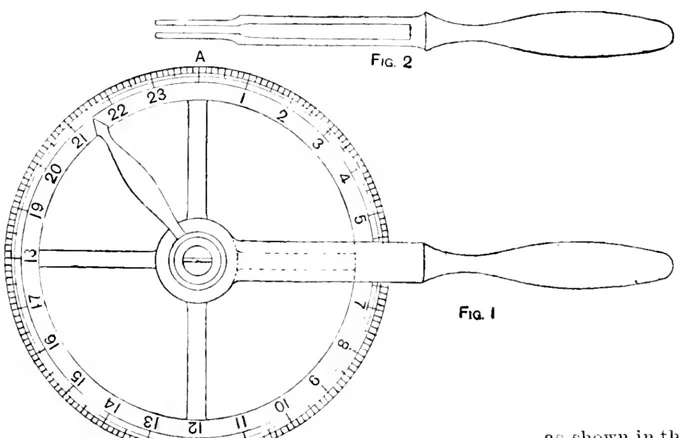
Driving Piles on a Batter.

or else to set them farther back at the foot, if the sills are long enough to allow of this being done. The piles will most likely require guiding by walings placed one row near the top and another row as low down as possible, as shown in Fig. 1. Sometimes a hinged joint is provided at the head of the piling machine after the fashion indicated in Fig. 2, where wrought-iron straps are shown bolted to the guides and shores, hingeing on a spindle that serves to carry the pulley. By this arrangement the machine may be set for driving vertically or at any required batter.

Making Alcohol from Sugar.—Alcohol is made from sugar by the following process. Dissolve 1 lb. of brown sugar in $\frac{1}{2}$ gal. of warm water; when the temperature has fallen to blood heat, mix a little of the solution with a teacupful of fresh brewer's yeast and add the mixture to the remainder of the solution. Allow it to ferment for from thirty-six to forty-eight hours, then skim off the yeast. Place the fermented liquor in a still and distil off about a quarter of it; the first portion passing over will contain most of the alcohol, but it will still be a weak spirit. To concentrate it, throw away the residue in the still and re-distil the portion that passed over, this time at a very low temperature. By careful rectification it is possible to obtain spirit containing 84 per cent. of alcohol; the 16 per cent. of water is removed by chemical agents.

Plumbers' Soil or Smudge. — Plumbers' soil or smudge is made in small quantities, as it deteriorates if kept. To make a soilpotful, place in the pot ¼ lb. of size or diluted molten glue and a little water; gently warm until the size dissolves, but do not boil. Mix ½ cub. in. of chalk ground to a fine powder with a pennyworth of lampblack, and then with a pallet knife incorporate some of the melted size with the mixture on a flat board or stone to form a thin paste, after which place the whole in the pot, warm, and stir together thoroughly. Try the soil on a piece of lead; if when dry it peels off, add water; if it is rubbed off easily, the size is not good, or the lead is greasy. Old and thick soil is thinned with porter or stout, but do not add too much or the soil will become so sticky that the solder will cling to it.

Tyring Cart Wheels.—After running off a wheel on a bar of iron to get the exact length it is necessary to know how much should be left to allow for the bending. No hard and fast rule can be given, as some brands of iron contract in bending more than others; but if 1 in. longer than the circumference is left, it will be sufficient. Having cut off the bar and bent the tyre, place the wheel to be tyred back uppermost on a tub or on the anvil, putting an iron rod through the centre of the stock and the hole in the anvil; traverse the sole with a measuring wheel, as Fig. 1, marking a joint on the wheel, starting from the normal point on the measuring wheel at A, and setting the dial hand to the point of starting after the wheel has been traversed. Then run round the inside of the bent iron, marking the dial point at the finish; this will give the approximate

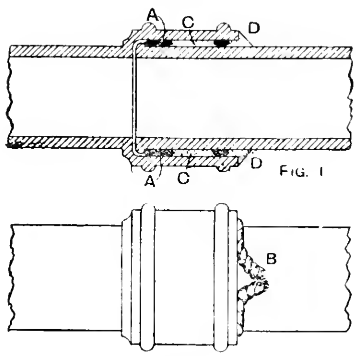


Measuring Wheel for Cart Wheels.

point for cutting off previous to upsetting and welding, which on an ordinary tyre generally take about ⅝ in. Bear in mind that the tyre when welded up must be smaller than the wheel, to contract it together when shrunk on; this varies according to the make and substance of the wheel, from ⅜ in. for a Warner wheel up to 1¼ in. smaller for larger and heavy wheels. After the tyre is welded, run it round again; it can be easily seen by the dial hand how much smaller the tyre is than the wheel, bearing in mind that the part made hot in welding will shrink about ⅛ in. in cooling; this must be carefully noticed in light work, otherwise, if the tyre is too tight, the spokes of the wheel will be crippled. Fig. 1 is the measuring wheel, ready for use; Fig. 2 is a side view of the handle of the measuring wheel.

Alcohols.—Alcohol is one member of a large series of organic products known by the generic term of alcohols. The lowest member of this series is methyl alcohol, which is contained in wood spirit; the next is ethyl alcohol, which is the ordinary alcohol; higher still are propyl alcohol and amyl alcohol, contained in fusel oil. There are also several others. Ordinary or ethyl alcohol is formed by the fermentation of sugar by means of yeast. There are two stages in the fermentation; in the first place, cane sugar takes up water and becomes "invert" sugar. This is then decomposed, yielding alcohol and carbonic acid. There are other minor products, but alcohol and carbonic acid are the principal ones. Starch in the form of potato starch, rice, barley, and Indian corn are also used in the preparation of alcohol, but they have first to be converted into sugar. This is done either with malt or with sulphuric acid. The alcohol produced is extremely weak; it is then distilled carefully, and leaves most of the water and all the solid matter in the still. Another distillation produces rectified spirit containing 84 per cent. by weight of alcohol. To prepare stronger alcohol, distillation should be repeated several times with quicklime, the final distillation yielding absolute alcohol, which should contain 95 to 99 per cent. of alcohol. Proof spirit contains 49 per cent. by weight of alcohol. Methylated spirit is rectified spirit to which 10 per cent. of wood spirit, or ⅜ per cent. of petroleum naphtha, has been added to render it undrinkable; it passes free of duty for manufacturing purposes. Whisky is made from malt and distilled as for rectified spirit; rum is made from molasses, gin from malt, etc., and brandy from French wines. Brandy, whisky, and rum must not be sold weaker than 25° under proof, *i.e.* containing not less than 40 per cent. of alcohol; and gin not less than 35° below proof, containing 37 per cent. of alcohol. Potato spirit made from potatoes, and "corn" spirit made from Indian corn or maize, are common alcohols containing much fusel oil. Still commoner alcohol is made from beet treacle. The three last are made and used largely in Germany, but not much in Great Britain. Wines contain from 10 to 20 per cent. of alcohol; beer as a rule contains about 5 per cent.

Joint for Hot-water Pipes. — The accompanying illustrations show a simple and efficient method of making joints in hot-water pipes. Fig. 1 is a section of the finished joint. To make the joint, first caulk tightly to the bottom of the socket two turns of yarn



Joint for Hot-water Pipes.

as shown in the section at A. Now cut a length of yarn sufficiently long to go once round the pipe, and to form a lip as shown at B (Fig. 2). Wrap the yarn round the pipe, and just press it into the socket, leaving a space between it and the back two turns, lay the ends outside on the top of the pipe so as to form the lip shown at B (Fig. 2). The space between the yarn is now filled, as shown at C in the section, with neat Portland cement mixed with water to the consistency of cream, by pouring it in at the lip B. Before the cement is set, turn in the ends of the yarn and caulk the last turn up against the liquid cement. When the joint is set, neatly plaster a ring of neat Portland cement D round the end of the socket, when the joint will be complete. The pipes may be filled with water in about twelve hours after completing the joints. These joints, if carefully made, will be perfectly tight, and not so liable to crack the sockets by expansion as a rust joint.

Renovating Bronze Ornaments.—To clean and renovate bronze ornaments that have gone dull and rough, try brushing the articles with a fine brush and powdered pumice-stone and water; if this does not have the desired effect, they will have to be dipped, cleaned, and re-bronzed. Well boil them in a solution made by dissolving ¼ lb. of caustic potash in 1 gal. of water, then dip them in clean water and dry. Any rough places must be smoothed down with a fine file or fine emery-cloth. Now dip the articles in an acid bath, wash, and dry. Make up a solution consisting of 1 gal. of water and 2½ oz. of iron perchloride or nitrate of iron, the latter for preference. When the iron salt has dissolved, immerse the bronzes for a short time; if not satisfactory, continue the immersion till the desired shade is obtained. The above solution will give any shade from brown to black. When the articles are quite dry, they may be preserved from further damp by coating with a very pale lacquer.

Weight of Air.—Regnault ascertained that at the freezing point of water (32° F.) a cubic centimetre of perfectly pure, dry air had a weight of 0·001292 of a gramme when the barometer stood at 76 centimetres at Paris. Of course, the earth attracts bodies more strongly at the poles than at the equator, though the slight difference can in ordinary practice be ignored. In English equivalents, a cubic foot of air has a weight of 0·080681 lb., or 1·29 oz., at 32° F. and at ordinary atmospheric pressure—that is, 14·7 lb. per sq. in. at sea level. The density, and consequently the weight, of air vary with its pressure and temperature. In ascertaining the weight of air exceedingly delicate apparatus is necessary, or there will be a large percentage of error in the result. The usual method is to weigh a bulb of glass or other material filled with air; the air is exhausted, and the bulb weighed again, the difference in the two weighings being the weight of the quantity of air that is sufficient just to fill the bulb. By ascertaining the cubical contents of the bulb, it is an easy matter to calculate the weight of any given quantity of air. The table below gives the absolute weights of a cubic foot of air under varying conditions of temperature and pressure. The weights given are those that would be obtained by weighing the air subject to the given conditions in an air-tight case surrounded by a vacuum; if the case were surrounded by the ordinary atmosphere, the case of air would appear to have a less weight. For example, 1 cub. ft. of air, temperature 70 F., pressure 80 lb. per sq. in. above the atmosphere, has an actual, absolute weight of 0·4825 lb.; weighed in air having a temperature of 70 F., the weight would appear to be only 0·4076 lb. The table printed above is on the authority of the *Locomotive*.

WEIGHT OF CUBIC FOOT OF AIR IN POUNDS.

Temp. F.	*Pressure in pounds per square inch, above atmosphere.*																						
	0	1	2	3	4	5	6	7	8	9	10	15	20	30	40	50	60	70	80	90	100	125	150	200
0	·0863	—	—	—	—	·1156	—	—	—	—	·1150	·1711	·2037	·2624	·3211	·3798	·4385	·4972	·5559	·6146	·6733	·8201	·9669	1·2604
10	·0845	—	—	—	—	·1132	—	—	—	—	·1419	·1706	·1994	·2568	·3143	·3717	·4292	·4866	·5441	·6915	·6590	·8026	·9462	1·2335
20	·0827	—	—	—	—	·1108	—	—	—	—	·1390	·1671	·1952	·2515	·3077	·3640	·4202	·4765	·5328	·5890	·6453	·7859	·9265	1·2078
30	·0810	—	—	—	—	·1086	—	—	—	—	·1361	·1636	·1912	·2463	·3014	·3566	·4117	·4668	·5219	·5770	·6321	·7699	·9076	1·1832
32	·0807	·0862	·0917	·0971	·1026	·1081	·1136	·1191	·1246	·1301	·1356	·1630	·1904	·2453	·3002	·3551	·4100	·4649	·5198	·5746	·6295	—	·9039	1·1781
40	·0794	—	—	—	—	·1064	—	—	—	—	·1334	·1604	·1874	·2414	·2954	·3494	·4034	·4574	·5114	·5654	·6195	·7545	·8895	1·1595
50°	·0778	—	—	—	—	·1043	—	—	—	—	·1308	·1572	·1837	·2367	·2896	·3426	·3955	·4485	·5014	·5544	·6073	·7397	·8721	1·1368
60	·0763	—	—	—	—	·1023	—	—	—	—	·1283	·1542	·1802	·2321	·2841	·3360	·3879	·4398	·4918	·5437	·5956	·7254	·8553	1·1149
70	·0749	—	—	—	—	·1004	—	—	—	—	·1258	·1513	·1768	·2278	·2787	·3296	·3806	·4315	·4825	·5334	·5844	·7118	·8391	1·0939
80	·0735	—	—	—	—	·0985	—	—	—	—	·1235	·1485	·1735	·2235	·2735	·3226	·3736	·4236	·4736	·5236	·5736	·6986	·8236	1·0736
90	·0722	—	—	—	—	·0967	—	—	—	—	·1213	·1458	·1704	·2195	·2686	·3176	·3658	·4159	·4650	·5140	·5631	·6859	·8086	1·0541
100	·0709	—	—	—	—	·0950	—	—	—	—	·1191	·1432	·1673	·2155	·2638	·3120	·3602	·4084	·4566	·5049	·5531	·6736	·7942	1·0353
110	·0696	—	—	—	—	·0933	—	—	—	—	·1170	·1407	·1644	·2118	·2591	·3065	·3539	·4013	·4486	·4960	·5434	·6618	·7802	1·0171
120	·0684	—	—	—	—	·0917	—	—	—	—	·1150	·1383	·1616	·2081	·2547	·3012	·3478	·3943	·4409	·4875	·5340	·6504	·7668	·9996
130	·0673	—	—	—	—	·0902	—	—	—	—	·1130	·1359	·1588	·2046	·2504	·2961	·3419	·3877	·4334	·4792	·5250	·6394	—	·9826
140	·0662	—	—	—	—	·0887	—	—	—	—	·1112	·1337	·1562	·2012	·2462	·2912	·3362	·3812	·4262	·4712	·5162	·6287	—	·9663
150	·0651	—	—	—	—	·0872	—	—	—	—	·1094	·1315	·1536	·1979	·2422	·2864	·3307	·3750	·4192	·4635	·5078	·6184	—	·9504
160	·0640	—	—	—	—	·0858	—	—	—	—	·1076	·1294	·1511	·1947	·2382	·2818	·3254	·3690	·4125	·4560	·4996	·6084	—	·9351
170	·0630	—	—	—	—	·0854	—	—	—	—	·1059	·1273	·1487	·1916	·2345	·2773	·3202	·3630	·4059	·4488	·4916	·5988	·7059	·9203
180	·0620	—	—	—	—	·0831	—	—	—	—	·1042	·1253	·1464	·1886	·2308	·2730	·3152	·3574	·3996	·4418	·4840	·5894	·6949	·9059
190	·0611	—	—	—	—	·0818	—	—	—	—	·1026	·1234	·1442	·1857	·2272	·2688	—	·3519	·3934	·4350	·4765	·5804	·6842	·8920
200	·0601	—	—	—	—	·0806	—	—	—	—	·1011	·1215	·1420	·1829	·2238	·2647	—	·3465	·3875	·4284	·4693	·5716	·6739	·8784
210	·0592	—	—	—	—	·0794	—	—	—	—	·0996	·1197	·1399	·1802	·2205	·2608	—	·3414	·3817	·4220	·4623	·5630	·6638	·8653
212	·0591	·0631	·0671	·0711	·0751	·0792	·0832	·0872	·0912	·0952	·0993	·1194	·1394	·1796	·2198	·2600	·3002	·3404	·3805	·4207	·4609	—	·6618	·8627
220	·0584	—	—	—	—	·0782	—	—	—	—	·0981	·1179	·1378	·1775	·2172	·2569	·2966	·3364	·3761	·4158	·4555	·5548	·6540	·8526
230	·0575	—	—	—	—	·0771	—	—	—	—	·0967	·1162	·1358	·1749	·2141	·2532	·2923	·3315	·3706	·4097	·4489	·5467	·6446	·8402
250	·0559	—	—	—	—	·0749	—	—	—	—	·0939	·1130	·1320	·1700	·2080	·2461	·2841	·3221	·3602	·3982	·4362	·5313	·6264	·8166
275	·0540	—	—	—	—	·0724	—	—	—	—	·0907	·1091	·1275	·1642	·2011	·2377	·2744	·3112	·3479	·3847	·4214	·5133	·6051	·7888
300	·0522	—	—	—	—	·0709	—	—	—	—	·0878	·1055	·1233	·1588	·1944	·2299	·2654	·3010	·3365	·3720	·4075	·4961	·5852	·7628
325	·0506	—	—	—	—	·0678	—	—	—	—	·0850	·1022	·1194	·1538	·1882	·2226	·2570	·2915	·3258	·3602	·3946	·4806	·5666	·7386
350	·0490	—	—	—	—	·0657	—	—	—	—	·0823	·0990	·1157	·1490	·1824	·2157	·2490	·2824	·3157	·3490	·3824	·4657	·5491	·7158

Making Koumiss.—Koumiss (spelt also kumyss) is a fermented liquor made originally by the Tartars from mares' milk; a somewhat similar liquor, called lebau or yaourt, is made from cows' milk by the Arabians and Turks; it is also prepared by the Russians under the name of kef. To prepare it, the milk is diluted with a little water, then placed in bags made of hides, and shaken till the cream is thrown up; it is then placed in earthen vessels and kept in a warm place until fermentation takes place. To hasten this, a little koumiss is added from a previous fermentation. The liquid is frequently well stirred to incorporate the curd and fat, and must be shaken before being drunk. The process is a true fermentation, the milk sugar being destroyed by a peculiar ferment with the production of lactic acid, alcohol, and carbonic acid. The liquid is said to have an agreeable sourish taste, and is sometimes recommended, though it is rarely seen, in England. One of the few means of getting the ferment in this country is to shake the milk in a bladder or to add some rennet. According to the *American Druggist*, koumiss commonly is made in America by adding yeast to cows' milk and then fermenting. The best results are, however, obtained from the use of mares' milk, this being the basic ingredient of the original Russian koumiss. Mares' milk is less rich in casein and fatty matter than cows' milk, and is therefore more easy of digestion. In the United States of America cows' milk is used always, and generally it answers the purpose well, but it is better to dilute the milk with water to reduce the percentage of casein, etc. Mares' milk contains 8·75 per cent. of milk sugar, cows' milk only 5·35; therefore it is necessary to add sugar to the preparation when made from cows' milk. The following recipe has been found to answer well. Dissolve 3 oz. of milk sugar in 32 oz. of water, and add the solution to 96 oz. of milk; rub together ⅓ oz. of compressed yeast and 2⅓ oz. of brown sugar in a mortar with a little of the mixture, and then strain into the other portion. Strong bottles are essential, champagne bottles being frequently used, and the corks should fit very tightly and be wired down; if the cork does not fit properly, the carbonic acid gas as formed will escape and leave a worthless preparation. The koumiss must be kept at a moderate temperature, and to ensure it being properly finished the bottles containing it should be gently shaken each day for about ten minutes to prevent the clotting of the casein. It is well to take the precaution of rolling a cloth round the bottle during the shaking process, as the amount of gas generated is great, and should the bottle be of thin glass or contain a flaw it may burst. Some few days elapse before the fermentation passes into the acid stage, and when this has taken place the preparation is much thicker. It is then in the proper condition for allaying sickness, being retained by the stomach when almost everything else is rejected. A fairly good quantity of koumiss may be prepared in a small way in the following manner. Fill a quart champagne bottle to the neck with pure cows' milk, add two tablespoonfuls of white sugar dissolved in a little warm water, and a very small quantity of compressed yeast. Then securely fasten the cork in the bottle and shake the mixture well; place it in a room having a temperature of from 70° to 80° F. for six hours, and finally in an ice box for about twelve hours, and it then should be ready for use.

Removing Tar from Black Cloth.—The best way to remove tar from black cloth is to immerse the soiled portion in benzene. After soaking for several hours renew the benzene, and with a hard nail-brush carefully brush away the stain.

Sliding Sashes in Railway Carriage Doors.—Fig. 1 is an elevation of the inside of a railway carriage door showing the strap for lifting the sash; Fig. 2 is a section through the door; whilst Fig. 3 is a detail showing the bottom rail of the sash and the method of holding the same in position when closed. The brass angle bar A is screwed to the underside of the bottom rail of the sash, and hooks over the bar B, fixed to the middle rail of the door. Sufficient space is left at the top to allow it to clear the bar B and fall into the groove E (Fig. 2). Differing in detail from the above is the railway carriage door with sliding sash, of which Fig. 4 shows a half inside elevation. From the section (Fig. 5) it will be seen that the door pillar is grooved from the top to within a few inches of the bottom, where a padded rail is put across the door; on this the sash falls. To take out the sash, the door is opened; the sash may then be pushed up through the top of the door, although some companies screw stops into the grooves above the sash to prevent the sashes being removed without the use of a screwdriver. In Fig. 6 the joint at the top of the sash at A has a circular corner, the square-cornered joint of the bottom rail being shown at C, Fig. 7. Sometimes the corner at C is mitred $\frac{1}{16}$ in., but as a rule the round is stopped on the stile and the mitre of the round worked up with the chisel. B, Fig. 6, is a section of the top rail and D, Fig. 7, a section of the bottom rail finished. The grooves are run right through the length of the stiles and rails, the tenons being made of the same thickness as the width of the grooves. From $\frac{3}{16}$-in. to $\frac{1}{4}$-in. polished plate glass is used, and the grooves are made larger to allow for a bedding of white-lead putty stained a mahogany colour. At D the method of fastening the strap and the bottom plate is shown. The sashes are planed, grooved, mortised, etc., by machinery, and knocked together; then the corners are cleaned up roughly by hand. The frame is then puttied and the glass put in. The joints are next cramped up, and the wedges (see Figs. 6 and 7) are dipped in glue and driven in. When these are dry the ends of the tenons and wedges are cut off level, and the frame is fitted into a gauge or into a door. It is then cleaned up, a piece of zinc being used to prevent the sandpaper scratching the glass; the top edge is then rounded, and the plate put on the bottom edge, when the sash or glass frame, as it is generally called, is ready for varnishing and polishing. On many railways the angle plate is not used, the rail under the sash inside being hinged to fall under the glass frame when it is raised; also some railways use both the angle plate and the falling "garnish" rail.

FIG. 2

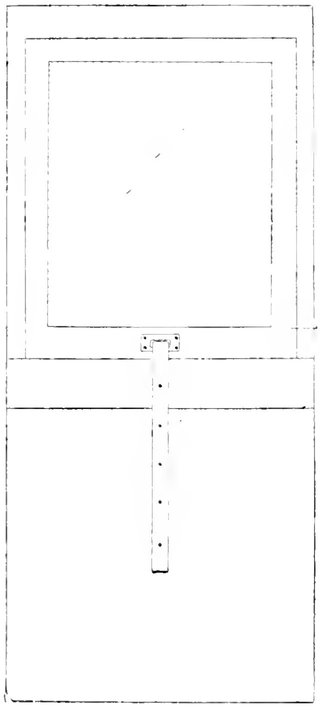


FIG. 1

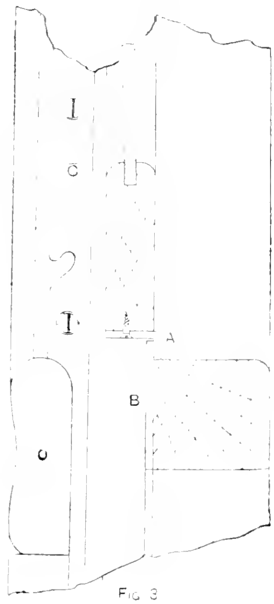


FIG. 3

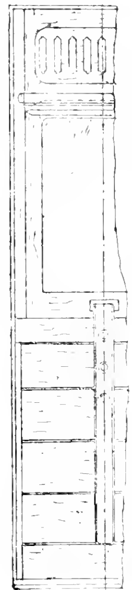


FIG. 4

FIG. 5

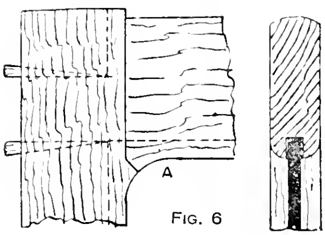


FIG. 6

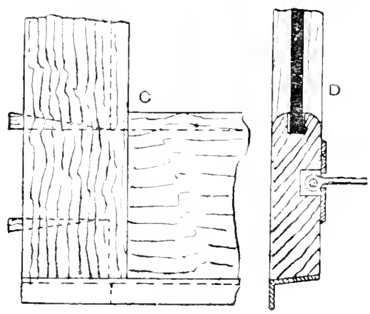


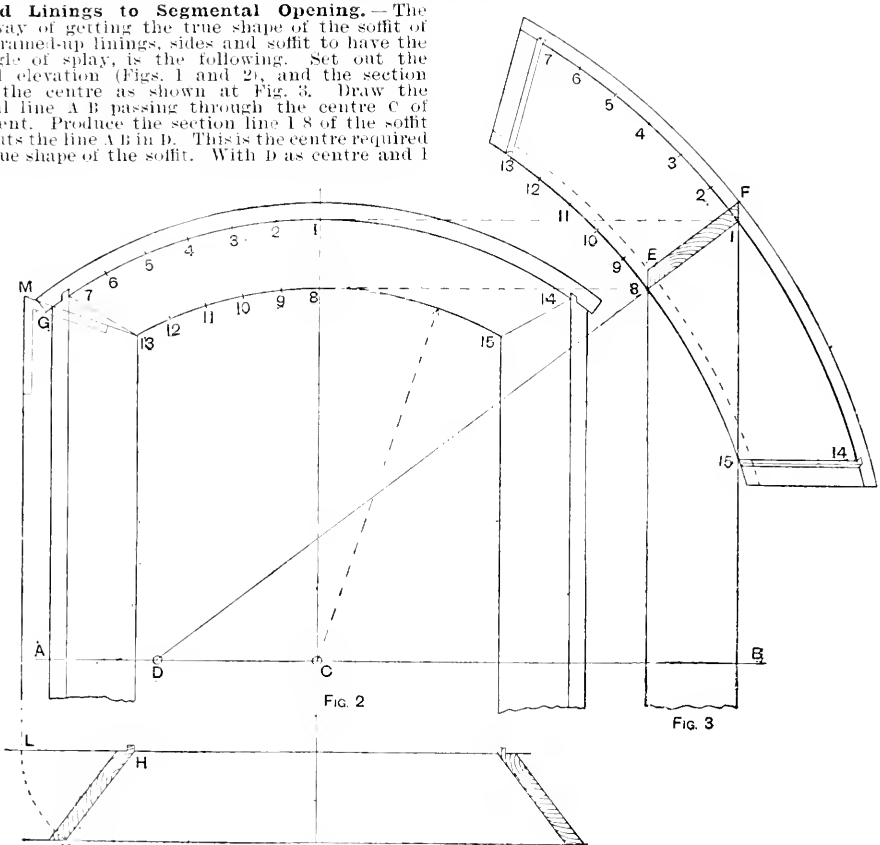
FIG. 7

Sliding Sashes in Railway Carriage Doors.

Renovating Maroon Repp Chair Covers.—To renovate faded and soiled maroon repp furniture covers, proceed thus. Strip the gimping, then with an old screwdriver knock up the tack heads sufficiently to allow them to be gripped with a pair of pincers; care must be exercised so as to damage the cover as little as possible. The majority of repps are very poor and threadbare at the back, owing to the thick diagonal cord being forced up with the weft yarn, leaving only the warp yarn slightly bound to form the backing; therefore the best method would be to have the covers French cleaned. Then put new gimp on the chairs; old gimp is not worth the trouble of relaying, unless it is of excellent quality.

Working Copper-plating Solutions. Copper-plating solutions, made by dissolving the green precipitate from a copper sulphate solution with potassium cyanide, should be worked hot. A temperature of from 150° F. to 180° F. gives the best results, the copper deposit being brighter and more coherent than at lower temperatures. When large bulks of alkaline copper solutions are necessary, and it is found inconvenient to heat them, it is advisable to precipitate the copper from a solution of its sulphate with liquor ammonia, then add more of this to dissolve the precipitate, and finally add the potassium cyanide. Work this cold and revive by adding a little liquor ammonia from time to time.

Splayed Linings to Segmental Opening.—The correct way of getting the true shape of the soffit of splayed framed-up linings, sides and soffit to have the same angle of splay, is the following. Set out the plan and elevation (Figs. 1 and 2), and the section through the centre as shown at Fig. 3. Draw the horizontal line A B passing through the centre C of the segment. Produce the section line 1 8 of the soffit until it cuts the line A B in D. This is the centre required for the true shape of the soffit. With D as centre and 1 and 8 as radii, draw the arcs 7, 1, 14, and 13, 8, 15. Now divide half of each of the upper and lower arcs in elevation (Fig. 2) into any number of equal parts as shown, then on the development (Fig. 3) set off distances exactly equal as shown by the corresponding figures. Join 7 to 13; this gives the true shape of the left-hand half of the surface of the soffit; the other half, of course, will be the same. The arcs drawn through E and F (Fig. 3) show the amount of bevelling to each edge. To get the bevel for the top of the jambs (or side linings), with H (Fig. 1) as centre draw the arc K L and project up to M, then project horizontally from 7 to M. Join M to 13, which will give the bevel G required, as shown.



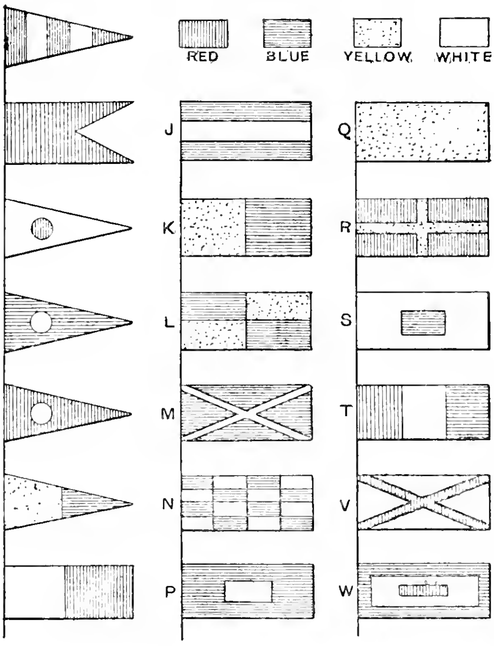
Splayed Linings to Segmental Opening.

Particulars of Copper.—Copper (Cu) is a highly malleable, ductile, and tenacious red metal greatly used in many industrial arts. It does not resist the action of acids, and even moisture affects it, causing it to form an oxide known as verdigris; this, under the action of carbonic acid, turns to a green carbonate. Copper is also caused to oxidise by heat; it is volatile only at a great heat. It has a specific gravity of 8·9, and melts at 2,000° F. Commercial copper contains many impurities, amongst them being iron, silver, bismuth, antimony, arsenic, cuprous oxide, lead, tin, and sulphur. Copper is much used in its commercially pure state, but is greatly in demand as the chief ingredient of the important brass and bronze alloys. Copper sometimes occurs native, being then often covered with an oxide and carbonate crust; it is sometimes found in grains in sand, but is more generally obtained by the reduction of its ores, which are very plentiful. The ores may be reduced—(1) by treating them in reverberatory or blast furnaces, or in both; (2) by the "wet" method; or (3) by the electro-chemical method. By one German furnace process the ore is oxidised and the sulphur expelled by roasting, and the ore is then smelted in a cupola, two cisterns receiving respectively the slag and metal which flow through tap-holes. Repeated roasting is necessary, and then all sulphates are removed by lixiviation. Silver is removed with lead, which is afterwards separated by cupellation. By another furnace method the copper pyrites is roasted together with chloride of sodium, sulphuric acid being formed; this attacks the soda, and the copper is turned into a soluble sulphate, the iron of the pyrites being then in the form of peroxide. The fumes of the chlorine, set free from the sodium chloride, impregnate lime, and this becomes a bleaching agent. The wet method of reducing copper ore is to grind and roast it, mix it with salt, and again roast it so as to form copper chloride and sodium sulphate, which are then dissolved in dilute acids. Any silver which may be in solution is precipitated by the action of zinc iodide, and the copper chloride solution is siphoned off and precipitated with scrap-iron. After washing the precipitate, it is refined in reverberatory furnaces. The copper from these may be cast into slabs, and to make these into thin sheets the slabs are annealed and rolled repeatedly, the rolls being brought nearer at each successive operation; the copper is annealed after each rolling.

Cleaning Gold.—To clean gold ware, mix together 2 parts of acetic acid, 1 part of oxalic acid, and 2 parts of sulphuric acid; stir in 2 parts of rouge, and mix with 200 parts of distilled water. Rub this on with a clean cloth, rinse off with hot water, and dry.

Gilding Metal Chains without Battery.—As metal chains, etc., gilded without the aid of a battery only take on the thinnest film of gold, they cannot be expected to stand any real wear, as the film of gold is easily rubbed off. The following solution may be used in gilding brass and copper chains. Dissolve ½ oz. of gold chloride in 1 qt. of distilled water, add 1 lb. of potassium carbonate dissolved in 1 qt. of distilled water, and boil the mixture for two hours. Swill the chains in the hot solution for a minute, rinse in hot water, and dry by shaking in sawdust. Silver and other metal chains may be gilded without a battery in an ordinary gold cyanide gilding solution by attaching a strip of zinc to the article. But in this case the gilding solution soon becomes contaminated with zinc.

Making Flags.—Flags are made of bunting joined by a double seam, the two edges being turned in. Sewing bunting cut diagonally is a rather awkward job. Silk is used for small and finer flags. Material may be economised by careful cutting; for example, the square of blue cut from the centre of the letter P (see illustration)



Signal Flags.

will do for the centre square of the code letter S. The red circle from the pennant F will come in for the centre of the pennant C, the white circle from C for the circle in D, and so on. Paint and prints are not satisfactory for making flags. The illustration shows the distinguishing colours and forms of the code. The flag shown at the top left-hand corner is the code signal and answering pennant. The flag Q hoisted alone at the mainmast head signifies that the ship is in quarantine. The flag P hoisted alone at the foremast head signifies that the ship, if in dock, is about to sail that day; if in the fairway, that the ship wants a pilot.

Antimony.—Antimony (Sb.) is a bluish white metal, crystalline and brittle, and so can be powdered easily. Its specific gravity is 6·7, and its melting point about 430° C. Its chief use is in the formation of serviceable alloys, such as Britannia metal, pewter, and Queen's metal, to which it imparts brittleness. The melted metal rapidly oxidises if exposed to the air, and if highly heated burns with a white flame, giving off fumes of antimony trioxide. Antimony is dissolved by hot hydrochloric acid, hot concentrated sulphuric acid, and aqua regia, and if treated with nitric acid forms a straw coloured powder known as antimonic acid. Commercial antimony contains impurities in the form of potassium, copper, iron, lead, etc. Antimony occurs native, but generally the metal is found in combination with others; the chief antimony ore is stibnite. The antimony is recovered from this ore by two distinct processes; by the first of these is separated the antimony sulphide, which is in its turn refined by the second process. In Germany, whence is obtained much of the commercial antimony, the ore is placed in covered pots having perforated bottoms, below which are receivers. Between the pots is the fire, the heat of which fuses the sulphide, which runs through the holes into the receivers. Crucibles heated in circular wind-furnaces are employed to refine the sulphide in England. The charge is 40 lb. of sulphide and 20 lb. of scrap-iron, and the product is antimony and iron sulphide, which is again melted, this time with sulphate of soda and some slag, a product of the next process. The resultant metal is melted with pearlash and slag, and cast into ingots. Antimony can be produced by electro-deposition.

Wire Gauges.—The table shows the value in inches of the sizes on the principal wire gauges.

Number of Gauge.	*London or Old English.*	*English Legal Standard.*	*Stubbs or Birmingham.*	*Brown and Sharpe.*	*Rodling.*
	Inches.	Inches.	Inches.	Inches.	Inches.
0000000	—	·5	—	—	—
000000	—	·464	—	—	·46
00000	—	·432	—	—	·43
0000	·454	·4	·454	·46	·393
000	·425	·372	·425	·40964	·362
00	·38	·348	·38	·364	·331
0	·34	·324	·34	·32486	·307
1	·3	·3	·3	·2893	·283
2	·284	·276	·284	·25763	·263
3	·259	·252	·259	·22942	·244
4	·238	·232	·238	·20431	·225
5	·22	·212	·22	·18194	·207
6	·203	·192	·203	·16202	·192
7	·18	·176	·18	·14428	·177
8	·165	·16	·165	·12849	·162
9	·148	·144	·148	·11443	·148
10	·134	·128	·134	·10189	·135
11	·12	·116	·12	·09074	·12
12	·109	·104	·109	·08081	·105
13	·095	·092	·095	·07196	·092
14	·083	·08	·083	·06408	·08
15	·072	·072	·072	·05706	·072
16	·065	·064	·065	·05082	·063
17	·058	·056	·058	·04525	·054
18	·049	·048	·049	·0403	·047
19	·04	·04	·042	·03589	·041
20	·035	·036	·035	·03196	·035
21	·0315	·032	·032	·02846	·032
22	·0295	·028	·028	·02534	·028
23	·027	·024	·025	·02257	·025
24	·025	·022	·022	·0201	·023
25	·023	·02	·02	·0179	·02
26	·0205	·018	·018	·01594	·018
27	·01875	·0164	·016	·01419	·017
28	·0165	·0148	·014	·01264	·016
29	·0155	·0136	·013	·01125	·015
30	·01375	·0124	·012	·01002	·014
31	·01225	·0116	·01	·00893	·0135
32	·01125	·0108	·009	·00795	·013
33	·01025	·01	·008	·00708	·011
34	·0095	·0092	·007	·0063	·01
35	·009	·0084	·005	·00561	·0095
36	·0075	·0076	·004	·005	·009

Cleaning Silver.—To clean silver ware, with a soft brush rub on a thin paste of equal parts of levigated (not precipitated) chalk and sodium hyposulphite rubbed up with distilled water. Rinse in clean water and dry in sawdust. Or let the paste dry on the silver, then rub off and rinse in hot water. To clean silver coins, immerse the coin in a bath of 1 part of sulphuric acid and 9 parts of water. In from five to ten minutes the crust of silver sulphide will have been dissolved; then rinse in clean water, rub with a soft brush and castile soap, rinse again, dry with a soft cloth, and rub with chamois leather. Silver-plated ware may be cleaned in this way. With a soft linen rag rub on a moistened mixture of 2 parts of cream of tartar, 2 parts of levigated chalk, and 1 part of alum, all in dry powder, and keep until required for use in a tightly corked bottle. Rub the plated ware lightly, rinse in hot soapsuds, and then in clean water, and dry in sawdust. Small plated articles blackened with silver sulphide may be dipped for an instant in dilute hydrochloric acid and then rinsed in clean water. Large articles blackened in the same way may be immersed in a 10 per cent. solution of sulphuric acid, or may be wiped with a swab carrying dilute nitric acid; always after applying acid rinse in clean water.

Preparing Whitewash.—A good way of preparing whitewash is to break up 6 lb. of whiting in a pail containing just sufficient water to cover the whiting; when the latter is thoroughly slaked and settled down, pour off the surplus water, stir the dissolved whiting with the bare hand and arm, and add 1 qt. of hot double size. Incorporate the two and set aside in a cool place to form a jelly. To prevent a yellow shade, grind a little indigo or ivory black in water and mix with the whiting and strain before adding the size. When required for use, dilute with cold water and use at once. Excess of whiting will cause the distemper to crack and flake; excess of size will impart an "egg-shell" gloss. To prepare a good ceiling whitewash, proceed as above as far as the slaking of the whiting; thoroughly mix it with the hand and stir in a hot solution of Young's patent size; use a cupful of size to every 2 gal. of the dissolved whiting. If the wash is to be perfectly white, potato starch may be used. Set aside to jellify, and then with a distemper brush rub it through a piece of coarse canvas stretched over the top of a pail. For use, dilute with cold clean water.

Fancy Dog-kennel.—Here is a design for a fancy panelled dog-kennel suitable for a room. The kennel may be about 20 in. long, 15 in. wide, and 14 in. high. Fig. 1 is a side elevation showing opening, Fig. 2 an end elevation, Fig. 3 a plan of the top, and Fig. 4 a cross section. Any strong wood may be used. The framing should be about ¾ in. thick, the panels ⅜ in., and the bottom ⅝ in. The top would require to be jointed, mitred, and tongued together. The framing could be rebated and the panels fixed from the back into the rebates. Moulding about 1 in. wide and mitred round as shown would improve the appearance.

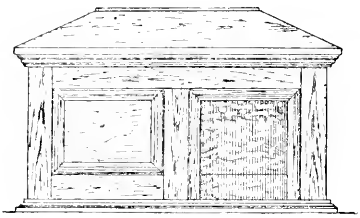


FIG 1

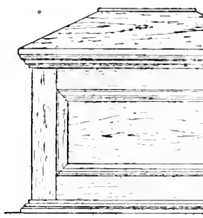


FIG. 2

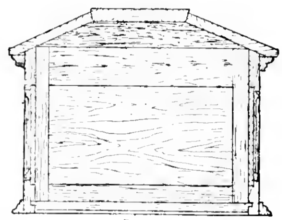


FIG 4

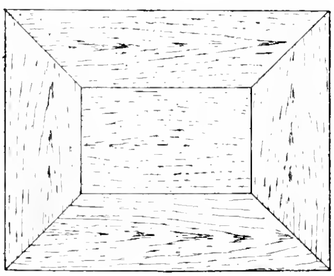


FIG. 3.

Fancy Dog-kennel.

Lead.—Lead (symbol Pb, melting point 612° F., specific gravity 11·4) is a bluish grey metal which is lustrous when freshly cut. Being very malleable, ductile, and tough, it is used largely in many of the crafts. It is devoid of elasticity, very soft, and can be cold-welded by pressure. Lead is not affected by most acids, but moisture and nitric acid rapidly oxidise it. If it is slowly cooled from its melting point, it crystallises into octahedrons. Sheet-lead is of two kinds, cast and rolled, the latter being known as milled; and it is jointed, when occasion requires, in one of two ways, soldering or burning. Lead is easily fused, and enters into the composition of many useful alloys, some of which are solders. Lead occurs in the form of ore, and generally as sulphide of lead, known commercially as galena. This has a metallic lustre, and often is in crystallised cubes, always containing silver. Less important lead ores are cerusite, a dirty white substance, containing, besides lead, carbon and oxygen; pyromorphite, a green, yellow, or brown ore containing, besides lead, phosphorus, carbon, oxygen, and chlorine; mimetesite, which is similar to pyromorphite, but contains arsenic in the place of phosphorus; and anglesite, a white or grey ore composed of lead, sulphur, and oxygen. In the reduction of the principal ore—galena—it is first picked, then broken and washed, most of the mechanical impurities being removed. The ore then is partially roasted or calcined for two hours in a reverberatory furnace, some of the ore becoming lead oxide and the rest becoming lead sulphate; some of the sulphur in the ore helps to form sulphurous acid, which escapes as gas. On raising the heat of the furnace, the oxide, sulphate, and unaltered sulphide react mutually, and form sulphurous acid and metallic lead; lime is thrown into the furnace during the latter stages of the process, at the end of which the molten lead is run off and the slag is removed.

Restoring the Lustre of Silver.—The best way to restore the original lustrous whiteness of silver goods, lost or impaired by exposure to sulphurous atmospheres or by having been often and perhaps carelessly cleaned, is first to anneal and then to pickle the silver, the latter portion of the process resembling the colouring of gold alloys. The annealing may be done in a charcoal fire or in the flame of a gas or oil blowpipe; the heat destroys all organic matter adhering to the surface of the article, at the same time oxidising on the surface the base metals with which the silver is alloyed. The annealing requires some care and attention, or else the workmanship of the piece will be lost. If the silver has been soft-soldered previously, it is unfit to be annealed, as the heat necessary for this would melt the solder. It is necessary to remove all stones, steel, or any material not silver or liable to be injured by the heat, and it is also advisable to remove pins, tongues, or other steel work from brooches, etc. Over- or under-heating must be prevented; in the former case, if the article is overheated, the silver is liable to melt; and if underheated, the adhering organic matter is not effectually destroyed, and the surface not sufficiently oxidised. In order to obtain the required degree of heat, and not to run a risk either of under- or over-heating, the article is held with a pair of pincers very close over the flame of the lamp so as to be covered with soot all over, and is then exposed to the blast of a flame by means of a blowpipe until the soot burns or disappears. When the article is cool, it is immersed in a boiling solution of from 1 part to 5 parts of sulphuric acid in about 20 parts of water. The quantity of the water depends upon the quality of the silver; the coarser this is, the stronger is the solution. The solution dissolves the extracted deposit of oxide and leaves a coating of fine silver on the surface. Good sterling silver will be whitened almost in an instant, common silver will take a minute or even longer; if the articles are left too long in the solution, they turn an unseemly greyish colour, and the process has to be repeated. Common silver has to be treated repeatedly in this manner before the desired whiteness is obtained, and in some cases even will have to be silvered by electro-plating. As soon as the article in the acid turns white it is transferred quickly to lukewarm water. The articles are then dried in sawdust, kept in an iron vessel near the stove or in any warm place. Any places on the article desired to look bright are burnished with a steel burnisher. Silver merely oxidised by exposure to the atmosphere, and not by repeated cleaning, is restored simply by brushing with a clean tooth brush and a little carbonate of soda.

Cleaning Furred Pipes.—A satisfactory method of removing fur or lime deposit from hot-water pipes has not yet been discovered, and it is generally better, and about as cheap, to put in new pipe. One method of removing the lime is to fill the apparatus with some scale-softening compound; but if this plan is adopted, the apparatus cannot be used for some days. Another method is to take out the pipes, make them hot, and then hammer the pipes outside in order to loosen the lime deposit so that it can be shaken out. This is not a perfect method, as hammering does not readily loosen the scale.

Particulars of Agate.—Agate, esteemed the least valuable of the precious stones, is a variety of quartz occurring usually as rounded nodules, known as geodes, or veins in trap rock and serpentine. Silica enters into its composition largely, and usually alumina and oxide of iron are present. The layers of chalcedony, carnelian, amethyst, common quartz, jasper, opal, and flint form bands of variegated colours, and these bands in the polished agate, by reason of their peculiar and distinctive arrangements, give to the several varieties their respective names, such as ribbon-agate, fortification-agate, zone-agate, star-agate, moss-agate, clouded-agate, etc.; also agates are named from the substance which forms the predominant layers, for example, jasper-agate, flint-agate, etc. The cutting and polishing of agates is an industry at Oberstein, in Oldenburg, Germany, and in Scotland also, where they are known as Scotch pebbles. Agate is used in finger-rings, for seals, beads, small handles, burnishers of many kinds, bearings in delicate mechanism, pivots, and for the knife-edges of weighing machinery, for which and other purposes its hardness peculiarly fits it.

Bronze Alloys.—Bronze is a yellowish, reddish, or chocolate-brown alloy of copper, tin, and other elementary metals, and is made in a similar way to brass; and indeed, there does not appear to be a sharp distinction between these two alloys. Below are given the proportions of some of the better known bronzes:—

Kind of Bronze.	*Aluminium.*	*Cast Iron.*	*Copper.*	*Gold.*	*Lead.*	*Nickel.*	*Tin.*	*Tungsten.*	*Zinc.*
Aluminium ..	9	—	91	—	—	—	—	—	—
Ditto	4·3	—	43	—	—	31	—	21·7	—
Ditto	10·3	—	55·3	—	—	—	—	—	34·4
Ditto	7·5	—	90	2·5	—	—	—	—	—
Antique	—	—	87	—	—	—	13	—	—
Ditto	—	—	97	—	—	—	3	—	—
Ash Grey	—	—	80	—	—	—	20	—	—
Bluish Red	—	—	84·2	—	—	—	15·8	—	—
Ditto ...	—	—	82	—	—	—	18	—	—
Dark Grey ..	—	—	76	—	—	—	24	—	—
Fontaine Moreau's	—	1	8	—	1	—	—	—	90
Ditto	—	—	8	—	—	—	—	—	92
Ditto ...	—	1	7	—	—	—	—	—	92
Ditto	—	0·5	2·5	—	—	—	—	—	97
Ditto	—	—	1	—	—	—	—	—	99
Hard ..	—	—	87·7	—	—	—	12·3	—	—
Reddish Yellow	—	—	88·8	—	—	—	11·2	—	—
Ditto	—	—	92·8	—	—	—	7·2	—	—
Ditto	—	—	94	—	—	—	6	—	—
Ditto ...	—	—	98	—	—	—	2	—	—
Statuary ...	—	—	88	—	1	—	9	—	2
Ditto	—	—	9	—	—	—	91	—	—
Whitish	—	—	69·6	—	—	—	30·4	—	—
Ditto	—	—	66·6	—	—	—	33·4	—	—
Ditto (best) .	—	—	33·4	—	—	—	66·6	—	—

Cleaning Silver Watch Dials.—Dirty silver dials having enamelled figures are cleaned in a different way from those having painted figures. If the figures are enamelled—and this can be ascertained by touching them with the point of a graver—the dial may be heated over an alcohol lamp, and then scoured with pulverised pumice-stone applied with a brush or by the fingers. Boiling for a few minutes in a copper cup containing chemically pure sulphuric acid diluted with twice its quantity of distilled water will render the dial snow-white without in the least injuring the enamelled figures. Rinsing in hot water and drying in hot sawdust completes the operation. If the dial has painted figures, the use of heat and acid are out of the question, and very careful handling is necessary if the figures are to be preserved. The cleaning or whitening may be performed by rubbing on the dial a thin paste of precipitated chalk and distilled water. The operation will be a lengthy one, but will be satisfactory if the necessary care is taken.

Stripping Gold from Gold-plated Ware.—By the following process the gold may be stripped from a gold-plated article, no matter whether it was fire or electrically gilt. Warm up an almost exhausted gold-plating bath, and use the plated ware as the anode. After the current has been active for a short time, the gold will be found to be entirely stripped from the article, and is recovered by diluting the stripping fluid with double the quantity of water and adding a solution of sulphate of iron. The gold will be precipitated in powder form, and may then be melted. The gold may be stripped also by means of a mixture of 10 parts of sulphuric acid, 2 parts of hydrochloric acid, and 1 part of nitric acid, in which it will gradually dissolve. The articles must always be entered in this mixture in a perfectly dry condition. To recover the gold, dilute this acid mixture with from ten to twelve times its quantity of water, and add a solution of iron. The gold in this instance also will be precipitated in the form of powder, and may then be smelted in the usual manner. If the shape of the article allows of it, the gold may be scraped off. The copper of the scrapings may be eaten out with nitric acid, after which the gold can be smelted.

Sealing-wax.—To prepare sealing-wax, melt together at a moderate heat 30 oz. of Venice turpentine and 45 oz. of shellac; stir well with a wooden stick and introduce, a little at a time, a mixture of 6 oz. of genuine Bologna chalk, 6 oz. of magnesia, and 28 oz. of vermilion, all in fine powder. When the mass is thoroughly mixed, pour in 7 oz. of turpentine, 3 oz. of a solution of mastic in turpentine, and 3 oz. of Peruvian balsam; heat the mixture again, stir well, and the sealing-wax is ready for pouring into suitable moulds. The above sealing-wax is red; for blue wax, substitute ultramarine for the vermilion; for yellow, use finely prepared and perfectly anhydrous chrome yellow; and for black sealing-wax, use finely powdered ivory black. Sealing-wax sticks having wicks through their centres are made with the same composition. The wick consists of from six to ten cotton threads saturated with wax or stearin; the wick is stretched tightly in a specially made mould, which is provided with a funnel through which the molten sealing-wax is poured. But little ingenuity is required to construct a suitable mould.

Polish for Calf Kid Boots.—The best polish for calf kid boots is white of egg; this should be kept till it is stale and forms a liquid, not a jelly. Ordinary blacking should not be used for calf kid boots. Another polish can be made by boiling pieces of calf kid, and adding a little gelatine, a very small portion of glycerine, and yellow soap; simmer up again, then strain and put in bottles.

Working Nickel-plating Solution.—A nickel solution for plating is at its proper working strength when it contains 1 lb. of nickel sulphate to the gallon of water. To maintain it at this strength attention must be paid to the anodes and their condition. As a rule, the surface of anodes exposed to the action of the solution should exceed by one-half the surface of the goods being plated. The anodes should also freely dissolve in the solution, and therefore should not be too hard. If nickel has been drawn from the solution too fast, it will be liable to become too acid, and this condition may be ascertained by testing it with blue litmus paper, which will quickly redden if acid is in excess. But a slight excess is permissible when plating iron and steel. An excess of acidity may be corrected by adding a small quantity of liquid ammonia; but an addition of nickel sulphate will be required also if the normal strength of the solution has been reduced. The hydrometer will show this reduction by comparing it with a sample of known correct strength. The readings on the hydrometer scale show the density of the solution, but not its temperature. Nickel-plating solutions are always worked cold.

Graining Walnut.—The ground colour for walnut graining is composed of 10 parts by weight of white-lead, 2 parts of yellow ochre, 1 part of burnt umber, and 1 part of patent driers, thinned with equal parts of raw linseed oil and turpentine. Let the work stand for forty-eight hours after the ground has been applied; then, with a lump of fuller's-earth and a damp sponge, damp down the ground. Brush over the panel with weak beer, burnt sienna, and a little vandyke brown, mottle it with a mottler, and soften with a badger. When dry, over-grain with a thin mixture of vandyke brown and weak beer, using the solution freely; employ over-grainers of different sizes, and so ten upwards. While this coat is still wet, add the dark veins and curl with an over-grainer and drop black. When the work is dry, glaze and shade with a mixture of vandyke brown and a little drop black. The panels should be darker than the moulding. Before varnishing, see that the work is clean, paying special attention to the quirks; see that all joints are sharp and clear. The varnish used should be of good quality, and must be applied on a dry day. If applied in wet weather it will bloom.

Putty or Cement for Glass.—A cement or superior putty for glass is the composition known as gilders' putty, the constituent parts of which are whiting, resin, glue, silver sand, and linseed oil; it sets as hard as metal, and can be moulded to any shape.

Dry Plates that can be Developed in Water.—Photographic dry plates that can be developed in water contain one of the developing agents in a film of gum on the back of the plate. On placing the plate in a specified quantity of water containing the alkali, the gum dissolves, liberates the reducing agent, and development commences. The process is recommended for the use of tourists, so as to avoid the necessity for carrying developing materials; but it is doubtful whether it possesses any advantages, as an accelerator and a restrainer and a glass measure must be carried. Tabloids are just as convenient, and probably more reliable, as the plates do not keep well; the plates are prepared as follows. Dissolve 100 gr. of pyro and 15 gr. of salicylic acid in 2 dr. of water and add 1 dr. of alcohol. Dissolve 150 gr. of gum arabic in 3 dr. of water. Mix the two, and brush over the back of the plates. About ½ dr. should be used for each quarter-plate. Allow to dry spontaneously. Expose as usual, and develop by immersion in water containing two to three drops of strongest liquor ammonia, ·880 per ounce.

Side-tipping Waggon.—Fig. 1 is a perspective sketch of a side-tipping waggon for brickmakers' clay showing the arrangement by which the waggon is swung from side to side. The sizes and measurements of these waggons vary according to the number of cubic feet of earth they have to carry. The waggon illustrated is about 33 in. long by 26 in. wide by 25 in. deep. The bolts on which it swings are 1½ in. in diameter, the space between the two middle bolts being 5¾ in. and the outer spaces 1½ in. These bolts rest on a 3-in. by 2-in. angle iron riveted to two 1-in. by 2-in. channel irons. Fig. 2 shows a swinging frame on which an ordinary waggon 33 in. long by 26 in. wide by 12 in. deep is run. Both frame and waggon are tipped up. The two bent-iron bars in the middle catch over the axles, thus preventing the waggon from falling out. Figs. 3 and 4 are, respectively, side and end elevations with dimensions of the sheet-iron frame.

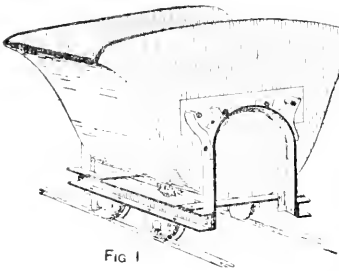


Fig. 1

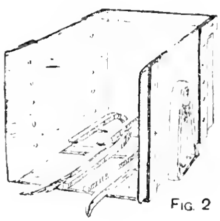


Fig. 2

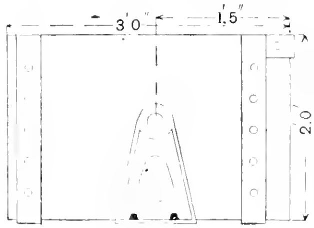


Fig. 3

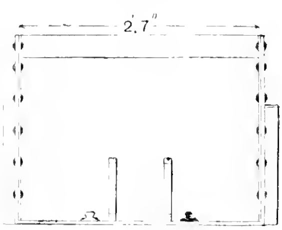


Fig. 4

Side-tipping Waggon.

Brasses.—Brass is a general name for alloys of copper and zinc. The colour varies with the proportions of the ingredients, though, strictly speaking, the term "brass" can be applied only to those copper and zinc alloys of a decided yellow colour. Ordinary brass is malleable and ductile, especially suitable for casting, and, though harder than copper, melts at a lower temperature than that metal. Unlacquered brass quickly tarnishes under atmospheric action. By one method of making brass, the zinc and other ingredients are plunged into the molten copper. When the whole is in a molten state, it is stirred with hot brass or iron rods to produce a thorough alloy; just previous to pouring, some sodium sulphate or sodium carbonate is thrown on to the metal to bring to the surface any impurities, which may then be skimmed. By another method, copper slips are plunged into liquid zinc until an alloy difficult of fusion is formed, when the rest of the copper is added. When cold, the alloy is broken into pieces and melted under charcoal, zinc or copper being added, if necessary, to give the requisite colour and quality. When at a suitable heat, the metal is poured into moulds. If the brass is to be made into sheet, it has to undergo a series of annealings and rollings until the desired thinness is attained. Below is given a short table of brass alloys:—

Name of Brass.	*Copper.*	*Lead.*	*Tin.*	*Zinc.*
Bright malleable	70	—	—	30
Common	50	—	—	50
Common pale	50	6	4	40
Emerson's patent (light)	66·6	—	—	33·3
English...	67	1	—	32
Ditto	70·29	0·28	0·17	29·26
Fine pale (brittle)	53·58	—	14·23	32·14
French	71·9	2	1	25·1
Pinchbeck	80	—	—	20
Red	83	—	—	17
Ditto	72	—	—	28
Rolled	75	—	3	22
Sheet-metal worker's ...	62	—	1	37
Ditto ...	90	—	—	10
Ditto	92·7	—	2·7	4·6
Ditto	67	0·5	0·5	32
Ditto	65	—	—	35
Ditto	83	—	—	17
Tombac...	88·8	—	5·55	5·55
White	10	—	10	80

Cleaning and Curling Feathers.—Feathers may be cleaned by washing them in clean water, using a soft cloth, and then absorbing the water with dry plaster-of-Paris. Another method is to wash them in soap and water, followed by clean water, and then by plaster. Or benzoline may be used, finishing with plaster if desired. In extreme cases, use hot water (steam is better), follow with turpentine, then with benzoline, using plaster last. When quite clean, the feathers may be curled by any of the following methods. (*a*) Place under one of the barbs a blunt knife (a table- or paper-knife), the thumb being on the top to regulate the pressure, and draw from the shaft outwards. Each of the barbs should be treated in this manner. This method, though slow and tedious, is the best. (*b*) Damp the feathers and place them in hair-curling pins for a couple of days. Then carefully comb out. (*c*) Slightly warm a goffering- or curling-iron, and curl the barbs in batches. Shake well. (*d*) If merely damp and out of curl, placing the feathers in front of a fire to dry will in many cases re-curl them. (*e*) Black (dyed) feathers can be curled by holding them for a few seconds in the smoke of a fire. No special tools are necessary, but the work requires care and patience.

Blackening Brass Pins.—Here is a method of darkening or blackening brass tacks and pins. Add to a solution of copper sulphate (bluestone) a strong solution of washing soda; allow this to settle, pour off the liquid, and add a quantity of water equal to the liquid poured off; then allow to settle again. Then pour off as completely as possible, take the green sediment with four times its value in water, heat to 140 F., and add ammonia gradually until the articles immersed in it assume the desired colour.

White Paste for Canvas Shoes.—This is a recipe for a white paste for canvas shoes. Scrape some pipeclay into a saucer, add a few pieces of oxalic acid and a very small portion of washing blue, and then pour on warm water till the paste is of the required thickness. If a paste of not quite such a dead white is desired, scrape in a little buff-ball after the oxalic acid has dissolved. In using the paste, first it is well rubbed into the shoes, and, when dry, rubbed out and then lightly brushed.

INDEX.

(*Illustrated Subjects are denoted by Asterisks.*)

B

C

H

I

J

K

L

M

P

Q

R

S

T

U

V

X

Y

Z

Printed by Cassell and Company, Limited, La Belle Sauvage, London, E.C.